U. S. ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

PC Code: 103801
DP Barcode: 351367

MEMORANDUM **March 4, 2009**

SUBJECT: Refined Tier II Drinking Water Exposure Assessment for the Section 3 New Use Registration of Oxamyl on Sugar Beets.

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1. EXECUTIVE SUMMARY

The Agency is considering a Section 3, New Use registration of oxamyl [(*EZ*)-N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide; CAS# 23135-22-0; PC Code 103801] on sugar beets. In 2007, a Tier II screening-level drinking water exposure assessment (DWA) was conducted for this proposed new use (DP barcode 337180; USEPA, 2007). Using the 2007 assessment, the Health Effects Division (HED) determined a potential for dietary risk from oxamyl residues in food and water based on the current and proposed uses. In order to further support HED's dietary risk assessment, the 2007 assessment was preliminarily refined in 2008 with regional percent cropped area (PCA) values and current models and methodologies to update exposure estimates for the maximum labeled rates and proposed use patterns (DP barcode 357440; USEPA, 2008). This assessment includes the refinements conducted in 2008 as well as further refinements that include characterization of the estimated exposure resulting from actual usage patterns, as recently described (DP barcode 359723; USEPA, 2009) by the Biological and Economic Analysis Division (BEAD).

Exposure estimates from the maximum use patterns, previously assessed in 2008 using regional PCAs and current models, are listed below in **Table 1**. The use on carrots resulted in the maximum 1-in-10-year peak and annual mean estimated exposure values in surface water. The use on ginger root resulted in the maximum exposure values in ground water. Because HED no longer compares surface water estimated drinking water concentrations (EDWC) to point levels of concern, the 30-year daily time series of EDWCs that the point estimates for surface water represent will be delivered with this assessment to HED for probabilistic modeling in support of human health dietary risk assessment.

Table 1. Refined estimated drinking water concentrations (EDWC) from maximum use patterns of oxamyl.

Drinking water source (model/data source)	Use (modeled rate)	Regional PCA	1-in-10-year peak (µg/L)	1-in-10-year annual mean (µg/L)	30-year mean (µg/L)
Surface water (PRZM/EXAMS)	Apples (2 lbs a.i./A/year)	87%	27	0.6	0.3
	Carrots (8 lbs a.i./A/year)	85%	**334**	**7.3**	2.9
	Citrus (6 lbs a.i./A/year)	38%	70	1.6	1.0
	Cotton (3 lbs a.i./A/year)	85%	123	2.4	1.2
	Cucumbers (6 lbs a.i./A/year)	67%	147	3.3	1.8
	Mint (4 lbs a.i./A/year)	87%	12	0.4	0.2
	Non-bearing fruit (8 lbs a.i./A/year)	38%	124	3.1	1.5
	Onions (4 lbs a.i./A/year)	67%	163	2.6	1.3
	Peppers (6 lbs a.i./A/year)	85%	256	4.7	2.2
	Potatoes (9 lbs a.i./A/year)	85%	231	5.9	**3.7**
	Sugar beets (4 lbs a.i./A/year)	87%	116	2.0	0.9
	Tomatoes (8 lbs a.i./A/year)	85%	208	4.5	2.4
Ground water (SCI-GROW)	Ginger root (10 lbs a.i./A/year)	N/A	**1.3**	**1.3**	**<1.3**
	Potatoes (9 lbs a.i./A/year)	N/A	1.1	1.1	<1.1
	Carrots, Tomatoes, Non-bearing fruit (8 lbs a.i./A/year)	N/A	1.0	1.0	<1.0
	Citrus, Cucumbers, Peppers (6 lbs a.i./A/year)	N/A	0.75	0.75	<0.75
	Mint, Onions, Sugar beets (4 lbs a.i./A/year)	N/A	0.50	0.50	<0.50
	Cotton (3 lbs a.i./A/year)	N/A	0.38	0.38	<0.38
	Apples (2 lbs a.i./A/year)	N/A	0.25	0.25	<0.25

Table 1. Refined estimated drinking water concentrations (EDWC) from maximum use patterns of oxamyl.					
Drinking water source (model/data source)	**Use (modeled rate)**	**Regional PCA**	**1-in-10-year peak (µg/L)**	**1-in-10-year annual mean (µg/L)**	**30-year mean (µg/L)**
Ground Water (PGW studies)	Cotton (4 lbs a.i./A/year)	N/A	3.9	N/A	N/A
	Tomatoes (8 lbs a.i./A/year)	N/A	1.5	N/A	N/A

In 2008, HED indicated that dietary levels of concern (for food plus water and accounting for number of eating occasions per day) are generally exceeded when EDWC time series are represented by a 1-in-10-year peak value near or above 80 µg/L (personal communication with Sheila Piper, Nov. 19, 2008). This indicates that the maximum use patterns for most modeled uses listed in **Table 1** may result in exceedances of dietary levels of concern. As a next step for characterization, EFED modeled a use pattern based on the usage data provided by BEAD when the 1-in-10-year peak EDWC for a maximum use pattern exceeded 80 µg/L for a given PCA region. These "actual" use patterns represent average numbers of applications per year and upper-bounds of the distributions of application rates that were reported for a crop in relevant regions of the U.S. This additional modeling estimates exposure from these lower application rates, which characterizes the potential maximum exposure that would result if maximum labeled rates were reduced to these lower modeled rates. Acute (1-in-10-year peak) estimated drinking water exposure estimates resulting from these "actual" use patterns exceeded 80 µg/L in some regions of the country for five of the modeled row crops. As a final step for characterization, uses on these five row crops were modeled again at 1 lb a.i./A applied once per year (an arbitrarily selected lower application rate). Resulting acute estimated drinking water exposure estimates were well below 80 µg/L.

The available monitoring data suggest that oxamyl may be detected in both ground water and surface water at concentrations as high as 100-400 µg/L in vulnerable areas. However, maximum concentrations observed in most monitoring studies were typically lower. The data suggest that oxamyl is not likely to be found in most surface waters and, when it is found, is not likely to persist. The compound is not expected to persist in neutral to alkaline ground water. Prospective ground water monitoring and non-targeted monitoring indicate that oxamyl may persist in some acidic ground water environments.

The major transformation products of oxamyl, oxime [methyl-2-(dimethylamino)-N-hydroxy-2-oxoethanimidothioate] and dimethyloxamic acid [DMOA; (dimethylamino)oxoacetic acid] are more mobile and more persistent than the parent, however environmental fate data are too limited to properly assess and characterize their fate in the environment. No transformation products of oxamyl are considered of toxicological concern. Therefore, oxamyl alone is the residue of concern in drinking water that is included in this assessment.

2. PROBLEM FORMULATION

This is a refined Tier II drinking water exposure assessment (DWA) that uses modeling and available monitoring data to estimate the ground water and surface water concentrations of pesticides in drinking water source water (pre-treatment) resulting from pesticide use on vulnerable sites. While Tier I DWAs are designed to screen out chemicals with low potential risk for posing a drinking water concern, the Tier II assessment provides more site-specific, refined modeling estimates of pesticide exposure by using additional environmental fate parameters, specific soil data, weather information, and management practices to estimate daily concentrations of pesticides for an extended period of time (up to 30 years).

A screening-level Tier II surface water exposure assessment was conducted in 2007 (DP barcode 337180; USEPA, 2007) for a proposed Section 3, New Use registration of oxamyl on sugar beets. This assessment reflected application of oxamyl at the maximum label rate and with scenarios intended to be representative of an environment that is more vulnerable to runoff and leaching than most where sugar beets and crops with existing uses of oxamyl may be grown. Using that assessment, the Health Effects Division (HED) determined a potential for dietary risk from oxamyl residues in food and water based on the current as well as the proposed use.

In order to further support HED's dietary risk assessment, the 2007 assessment was preliminarily refined in 2008 with regional percents cropped area (PCA) and current models and methodologies to update exposure estimates for the maximum labeled and proposed use patterns (DP barcode 357440; USEPA, 2008). This assessment includes the refinements conducted in 2008 as well as further refinements that include characterization of the estimated exposure resulting from "actual" use patterns, as recently described (DP barcode 359723; USEPA, 2009) by the Biological and Economic Analysis Division (BEAD). It is important to note that this assessment does not estimate exposure from all currently labeled uses of oxamyl; the subset of currently labeled uses that were assessed were selected based on amount of usage or maximum application rate. Exposure estimates in this assessment may underestimate exposure in regions of the U.S. where uses that were not assessed occur.

2.1. Background

Oxamyl [(*EZ*)-N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide; CAS# 23135-22-0; PC Code 103801] is an N-methyl carbamate insecticide/nematicide and a cholinesterase inhibitor. Oxamyl is currently registered as a restricted use acaricide, insecticide, nematicide and plant growth regulator for the control of a broad spectrum of insects, mites, ticks, and nematodes on various field crops, vegetables, fruits, and non-bearing trees (refer to the Use Characterization for details). The active ingredient is applied in liquid formulations by soil injection, aerial, ground or chemigation application equipment.

The Agency assessed the risks of oxamyl and reached an Interim Reregistration Eligibility Decision (IRED) for this carbamate pesticide (USEPA, 2000) that was finalized in the 2007 Reregistration Eligibility Decision (RED) for the N-methyl carbamate group of pesticides (USEPA, 2007). Oxamyl is currently being considered for a Section 3, New Use registration on sugar beets.

2.2. Use Characterization

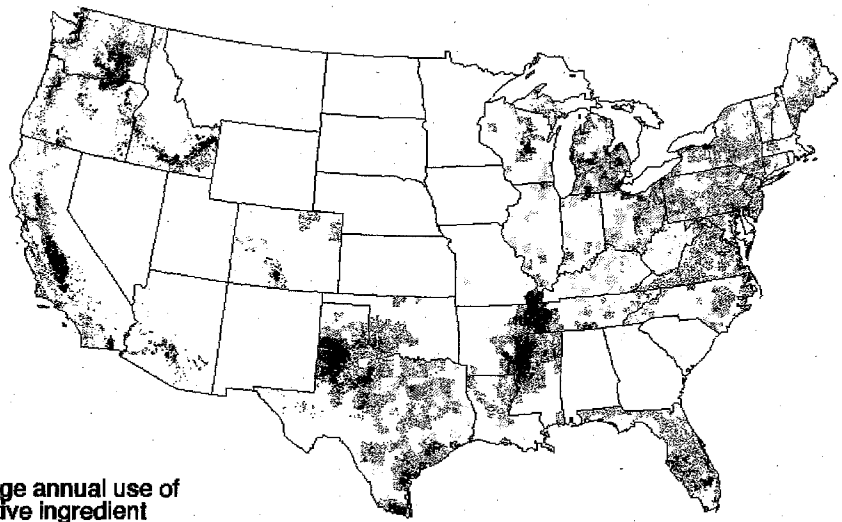
Oxamyl is an acaricide, insecticide, nematicide, and plant growth regulator used on a variety of terrestrial food, feed, and non-food crops. The active ingredient is applied in liquid formulations by aircraft and ground spray equipment, irrigation (gravity, drip, low pressure, sprinkler), and a variety of soil incorporation equipment. The liquid formulation end-use products for oxamyl are: VYDATE® C-LV (42% a.i.) and VYDATE® L (24% a.i.).

The proposed label for sugar beets recommends applications of 1 to 2 lbs a.i./A of VYDATE® C-LV either in-furrow or via soil injection (shank) at planting. If applications are made by soil injection, water in the soil injection (shank) application via furrow or overhead irrigation must be applied immediately after planting. The label also allows applications of 1 lb a.i./A of VYDATE® C-LV as a foliar banded spray approximately 7- 10 days prior to the anticipated peak emergence of adult sugar beet root maggot flies and another 1 lb a.i./A application as a foliar banded spray approximately 10 days later. VYDATE® C-LV may also be used following the use of an at-plant or at-cultivation application of an insecticide labeled for use on sugar beet. Two additional 1 lb a.i./A foliar banded applications may be made as needed on a 10 day application interval. The labeled maximum application per season is not to exceed 4 lbs a.i./A.

Figure 1 presents the national agricultural usage pattern of oxamyl in 2002 (USGS, 2009). At that time, cotton consisted of 49% of the national usage, followed by potatoes at 27%, and mint, onions, tomatoes, and other crops, each at <7% of the national usage. These data are relatively consistent with BEAD's Screening Level Usage Analysis (SLUA) of oxamyl (dated June 21, 2007) based on source data from 2000 to 2005 (USEPA, 2007a). The SLUA reports that cotton (300,000 lbs), corn (200,000 lbs), and potatoes (200,000 lbs) account for the greatest amount of use (the use on corn is expected to reflect either a reporting error or a misuse of oxamyl), followed by mint (60,000 lbs) onions (30,000 lbs), celery (20,000 lbs), grapefruit (20,000 lbs), and other crops.

OXAMYL - insecticide

2002 estimated annual agricultural use



Crops	Total pounds applied	Percent national use
cotton	350964	49.23
potatoes	189011	26.51
mint for oil	49651	6.96
dry onions	38703	5.43
tomatoes	19751	2.77
citrus fruit	13542	1.90
celery	13137	1.84
apples	9029	1.27
carrots	8772	1.23
bell peppers	5140	0.72

Figure 1. National Agricultural Usage of Oxamyl in 2002 (USGS, 2009).

As was done in the 2007 assessment, this assessment considers the maximum use pattern of the labeled uses as well as the proposed use on sugar beets. These use patterns are used with modeling scenarios to estimate exposure that is higher than at most potential use sites due to a combination of use pattern and site vulnerability. Evaluated uses include the proposed use on sugar beets, the major uses (cotton and potatoes), and a selection of other currently labeled uses, including mint, dry onions, tomatoes, citrus, apples, carrots, peppers, and cucumbers. Seasonal application rates are assumed in this assessment to be annual application rates. Although this is not generally a conservative assumption for crops that may have multiple seasons per year, oxamyl is expected to degrade sufficiently between seasons to allow exposure estimates representing one season per year to approximate those that would represent multiple (*i.e.*, three) seasons per year.

Application information for all uses is presented in **Table A1** in **Appendix A**. The maximum use patterns that were considered in this assessment are summarized in **Table 2**.

Table 2. Maximum use patterns for current and proposed foliar uses of oxamyl.								
Use Pattern	**Current/ Proposed**	**Formula**	**Geographic Applicability**	**Single App. Rate (lbs a.i./A)**	**Max. Number of App.**	**Seasonal App. Rate (lbs a.i./A)**	**App. Interval (days)**	**App. Method[a]**
Apples (bearing)[b]	Current	Vydate® L	U.S.	2	4	2	N/A	Ground
Carrots	Current	Vydate® L	Except CA	4, 1[c]	8	8	NR	Ground
Citrus (bearing)[b]	Current	Vydate® L	U.S.	1	6	6	15	Aerial
			CA, AZ	2	6	6	30	Aerial
Cucumbers	Current	Vydate® L	U.S.	1	8	6	7	Aerial
Cotton	Current	Vydate® L, Vydate® C-LV	CA, AZ only	1	8	3	6	Aerial
			Except CA, AZ	0.5	8	3	6	Aerial
Dry onions	Current	Vydate® L	CA	2	3	4.5	14	Ground
			ID, OR, WA	4, 2[c]	8	4.5	NR	Ground
			MI, TX	4, 2[c]	8	4.5	14	Ground
			NM	0.5	8	4.5	5	Aerial
Ginger root	Current	Vydate® L	HI	4, 1[c]	8	10	30	Ground
Mint	Current	Vydate® L	ID, MI, MT, OR, WA, WI	2	2	4	21	Ground
Non-bearing fruit[b]	Current	Vydate® L	U.S.	2	8	8	NR	Ground
				1				Aerial
Peppers	Current	Vydate® L	U.S.	1	8	6	7	Aerial
Potatoes	Current	Vydate® L , Vydate® C-LV	Northeast & Mid-Atlantic states	1	8	6	5	Aerial
			Except Northeast & Mid-Atlantic states	4, 1[c]	8	9	5	Ground
Sugar beets	Proposed	Vydate® C-LV	Except CA	2	Not stated	4	10	Ground
Tomatoes	Current	Vydate® L	U.S.	1	8	8	5	Aerial

a Listed application methods represent those of the maximum use pattern and do not represent all labeled application methods for that use.
b Use patterns for apple trees and citrus trees bearing fruit are different than for fruit trees not bearing fruit, including apple, cherry, citrus, peach, and pear trees.
c The first value is for at-plant applications; the second value is for following applications.

In order to characterize reductions in exposure estimates resulting from potential changes to the proposed and currently labeled use patterns, usage data were requested from BEAD for use on carrots, peppers, oranges, grapefruit, lemons, cotton, cucumber, onions, sugar beets, and tomatoes for U.S. states where exposure concern was identified. BEAD provided the requested usage data at the state-level and at the application-level, such as per crop stage, where possible using data from 2003 to 2007 (DP barcode 359723; USEPA, 2009). Application rate distributions based on data from 1998 to 2007 were also provided. Based on these data, "actual" use patterns were identified for modeling with PRZM/EXAMS to estimate their resulting exposure and to help HED explore whether the reduced exposure would result in dietary risk exceedances (**Table 3**). "Actual" numbers of application per year reflect average reported values. Where fractional values were reported, they were rounded up to the next highest integer. "Actual" application rates reflect upper-bounds (81%-100%) of the reported distributions.

Table 3. "Actual" use patterns for current foliar uses of oxamyl.					
Use Pattern	**Single App. Rate (lbs a.i./A)**	**No. of App. per Year**	**Seasonal App. Rate (lbs a.i./A)**	**App. Interval (days)**	**App. Method**
Carrot	1.0	2	2.0	5	Ground
Cotton	0.50	2	1.0	6	Aerial
Cucumber	1.0	2	2.0	7	Aerial
Dry onion	0.5	7	3.5	5	Aerial
Non-bearing fruit	1.0	2	2.0	7	Aerial
Pepper	1.0	2	2.0	7	Aerial
Potato	1.5	2	3.0	7	Ground
Tomato	1.5	3	4.5	5	Ground

The "actual" number of applications per year was reduced from the maximum labeled value for all uses. The "actual" number of applications was also reduced from the maximum modeled value for all uses, with the exception of use on dry onions, in which case the maximum single application rate is similar to the maximum seasonal application rate, whereas the "actual" application rate is low enough for an "actual" seven applications per year to occur without exceeding the maximum seasonal application rate. Application methods and intervals were adjusted to reflect maximum labeled use instructions at "actual" application rates. For example, the application method to tomatoes was changed from aerial to ground-level foliar broadcast or chemigation because the "actual" application rate for use on tomatoes is greater than 1.0 lb a.i./A, which is the limit for aerial applications according to the RED and the application rate that characterizes the maximum modeled use pattern. Also, the "actual" application method to dry onions was changed to aerial application and the interval was shortened to 5 days.

2.3. Conceptual Model

Oxamyl is very soluble in water (2.8 x 10^5 mg/L) and mobile to highly mobile, tending not to partition to soil, aquifer solids or sediment (K_{OC} range of 2.5 to 60 L/kg$_{OC}$). Oxamyl is likely to reach surface sources of drinking water via spray drift and runoff, and ground water via leaching. However, once oxamyl has entered surface water, it is not likely to persist, and will degrade by chemical and biological processes including photolysis (half-life of 14 days) in near surface clear waters, and hydrolysis in alkaline (half-life of 3 hours at pH 9) and neutral (half-life of 8 days at pH 7) waters. Microbially mediated processes will also degrade oxamyl in aerobic water bodies (half-life of 3.5 days), aerobic soils (half-life of 3-112 days), and anaerobic soils (half-life 5-6 days). Oxamyl is not expected to persist in ground water under most circumstances because of its susceptibility to hydrolysis in neutral and alkaline conditions. However, oxamyl may persist in ground water that tends to be acidic and that is abiotic. Oxamyl continues to be found in ground water in New York decades after its use was locally restricted. There is also evidence that suggests that reduced iron phases can catalyze oxamyl degradation. If this is so, oxamyl will not persist in strongly reducing (highly anaerobic) conditions where Fe(II) would be expected to be present.

3. ANALYSIS

3.1. Environmental Fate and Transport Characterization

Oxamyl [(*EZ*)-N,N-dimethyl-2-methylcarbamoyloxyimino-2-(methylthio)acetamide; CAS# 23135-22-0; PC Code 103801] is hydrophilic, mobile to highly mobile, and relatively nonvolatile (see **Figure 2** for structure). The compound dissipates in the environment by chemical and microbially-influenced degradation and by leaching, with estimated half-lives on the order of days to weeks. Environmental fate studies submitted and/or reviewed since the 2007 drinking water exposure assessment are considered in this refined assessment. These studies refine our understanding of the aqueous photolysis, aerobic soil metabolism, aerobic aquatic metabolism, batch equilibrium, and terrestrial field dissipation of oxamyl. Including these studies, **Table 4** is a tabulated summary of the submitted environmental fate data for oxamyl that are acceptable for use in exposure assessment. The environmental fate of oxamyl is further characterized below with explanations of what has changed since the last assessment.

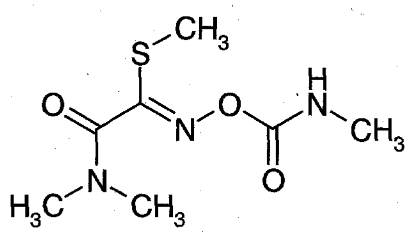


Figure 2. Structure of Oxamyl.

Table 4. General Chemical Properties and Environmental Fate Parameters of Oxamyl.		
Parameter	**Value**	**Reference**
Physical/Chemical Parameters		
Molecular mass	219.3 g/mol	MRID 40499702
Vapor pressure (25°C)	3.84×10^{-7} torr	MRID 42526101
Water solubility (20°C)	2.82×10^{5} mg/L	MRID 40499702
Octanol-water partition coefficient (K_{OW})	0.36	MRID 40499702
Persistence		
Hydrolysis half-life	pH 5: >31 d pH 7: 8 d pH 9: 0.125 d	MRID 40606516
Aqueous photolysis half-life	14.2 d (pH 5)	MRID 40606515; 41058801
Soil photolysis half-life	No evidence of degradation	Acc. No. 147704
Aerobic soil metabolism half-life	11 d (silt loam, pH 6.4, OM 2.8%) 17 d (silt loam, pH 6.4, OM 2.8%)	Acc. No. 63012
	11 d (sandy clay loam, pH 7.7, OM 1.5%)	MRID 42820001
	2.9 d (silt loam, pH 7.0, OM 0.4%) 4.6 d (silt loam, pH 7.8, OM 2.1%) 112 d (silty clay loam, pH 4.8, OM 4.4%)	MRID 45176602
Anaerobic soil metabolism half-life	5.2 d (silt loam, pH 4.6, OM 3.7%) 5.8 d (sandy clay loam, pH 7.7, OM 1.5%)	MRID 41346201 MRID 42820001
Aerobic aquatic metabolism half-life	3.4 d; hydrolysis-corrected: 6.1 d (sandy loam, pH 6.6-7.8) 3.5 d; hydrolysis-corrected: 6.3 d (sandy loam, pH 6.9-8.3)	MRID 45045305
Mobility		
Organic carbon partitioning coefficient (K_{OC})	10-60 L/kg_{OC} (5 soils) 6-10 L/kg_{OC} (3 soils) 2.5-8.7 L/kg_{OC} (6 soils)	MRID 46237301 Bilkert and Rao, 1985 Bromilow et al, 1980
Column leaching (% parent in leachate; % identified residues in leachate)	<0.2-83%; 89-100% (6 unaged soils) 21-50%; 37-67% (3 aged soils)	Acc. No. 141395 MRID 40606514
Field Dissipation		
Terrestrial field dissipation half-life	Not determined (NY) Not determined (CA) 4 d (DE) 3 d (FL), 4 d (CA), 19 d (WA) 8.6 d (MS) (Oxamyl detected at deepest sample depths of each study.)	Acc. No. 145302 Acc. No. 149231 Acc. No. 40494 MRID 41573201; 41963901 MRID 45045304

Major degradates of oxamyl include oxime [2-hydroxyamino-N,N-dimethyl-2-(methylthio)acetamide], DMOA [N,N-dimethyl-oxalamic acid], DMCF [cyano-methanoic acid dimethylamide], DMEA [N,N-dimethyl-oxalamide], and carbon dioxide. **Table C1** of **Appendix C** summarizes these major degradates along with the maximum amounts and at what sampling interval they were detected in each of the environmental fate studies. Similar to oxamyl parent, oxime is highly mobile; DMOA, DMCF, and DMEA are expected to be highly mobile as well. Furthermore, oxime and DMOA are more persistent than oxamyl in certain conditions, such as abiotic conditions in the case of oxime.

3.1.1. Degradation

Hydrolysis of oxamyl is pH-dependent, as oxamyl degrades rapidly in neutral to alkaline environments (half-life of 8 days and 3 hours at pH 7 and 9, respectively) and persists in acidic conditions (relatively stable at pH 5; MRID 40606516). Oxamyl is moderately photolyzed in acidic, clear, near surface water (half-life of 14 days at pH 5; MRID 40606515; 41058801) but is not photolyzed on soil (Acc. No. 147704). The aqueous photolysis half-life is twice as long as that reported for the study in previous assessments because the previously reported value of 7 days reflected continuous irradiation and the current value is adjusted for a 12-hour per day irradiation period. Also, previously reported aqueous photolysis half-lives of 4-11 days (from Acc. No. 40494) are not acceptable for use in exposure assessment and are not reported here. The major hydrolysis (pH 7 and 9) and aqueous photolysis transformation product is oxime, which comprised 83-93% of the applied radioactivity by the end of the hydrolysis studies (pH 7 and 9), and up to 75% at the end of the photolysis studies. Although these studies were not conducted long enough to track a pattern of decline, they suggest oxime may be more persistent to hydrolysis and photolysis than oxamyl.

In aerobic aquatic systems, oxamyl degrades with a half-life of 3.4-3.5 days at pH 6.6-8.3 (these data were not reviewed during the previous assessment; MRID 45045305). The biodegradation half-life corrected for hydrolysis at pH 7 is 6.1-6.3 days (*i.e.*, the pH 7 hydrolysis rate constant was subtracted from the degradation rate constants in aerobic aquatic systems in order to yield these rate constants for biodegradation alone). The major transformation products are oxime, DMOA, DMCF, DMEA, and carbon dioxide. In one study system, oxime reached 59% of the applied radioactivity after 1 day and DMOA totaled 79% of the applied after 30 days. In another study system, DMCF and DMEA were up to 55% and 14% of the applied, respectively, after 2 days. Carbon dioxide in these systems totaled 31-75% of the applied.

In aerobic soil, oxamyl degraded with a half-life ranging from 3 to 17 days in five of six tested soils (pH 6.4 to 7.8) and degraded with a half-life of 112 days in one tested soil (pH 4.8; Acc. No. 63012; MRID 42820001; 45176602). The wide range in half-lives is likely due to variation in pH, as degradation may reflect hydrolysis as well as microbial metabolism (all soils remained viable throughout the study). This range of half-lives is based on data in MRID 45176602 that had not been reviewed for the previous assessment and includes the previously reported range of 11 to 27 days. Previously reported values from studies recently determined as not acceptable for use in exposure assessment (Acc. No. 40494; 154748; MRID 41346201) are no longer reported. The major transformation products are oxime, DMOA, and carbon dioxide. In one aerobic metabolism study, oxime peaked at 24% of the applied radioactivity after 10 days, DMOA reached 20% of the applied after 21 days, and carbon dioxide comprised 45% of the applied after 51 days (MRID 42820001). In another study, oxime comprised up to 51% of the applied after 7 days; DMOA was a maximum of 35% of the applied in a separate soil after 10 days; in both soils, carbon dioxide totaled 73-76% of the applied at study termination (MRID 45176602).

In anaerobic soil, oxamyl degrades with a half-life of 5 to 6 days (2 soils; pH 4.6-7.7; MRID 41346201; 42820001). Data from studies recently found not acceptable for use in exposure assessment (Acc No. 40494; 113366) were not included in the current assessment. In a 32-day anaerobic study, oxime peaked at 70% at 20 days of flooding, declining to 22% at the end of the study; DMOA peaked at 23% at 32 days (MRID 42820001). In another anaerobic study, oxime only formed a maximum of 2% of the applied, while DMOA peaked at 86% of the applied after 30 days of flooding, remaining 74% of the applied at study termination (MRID 41346201).

3.1.2. Mobility

Oxamyl has little affinity for adsorption on a variety of soils and is mobile to highly mobile according to the FAO soil mobility classification scheme (USEPA 2006). In a submitted batch equilibrium study that had not been reviewed during the previous assessment (5 soils), average soil-water partition coefficients (K_d) ranged from 0.12 to 0.80 L/kg and organic carbon partitioning coefficients (K_{OC}) ranged from 10 to 60 L/Kg$_{OC}$ (adsorption to one soil was too low to calculate a Freundlich isotherm; MRID 46237301). Adsorption to soil was correlated to soil organic carbon content, demonstrated by less variability in K_{OC} values compared to that in K_d values. Batch equilibrium studies in the open literature reported a lower range of organic carbon partition coefficients (range of 2.5 to 10 L/Kg$_{OC}$ for 9 soils; Bilkert and Rao, 1985; Bromilow *et al.*, 1980). Oxime has similar mobility to oxamyl parent, with K_d values ranging from 0.33 to 0.67 L/kg (5 soils) and K_{OC} values ranging from 18 to 66 L/Kg$_{OC}$ (MRID 46237302). Previously reported batch equilibrium data from Acc No. 40494 and 154748 were not included in this assessment, as they were found not acceptable for use in exposure assessment.

Soil column leaching studies confirm the mobility of oxamyl (Acc. No. 141395; MRID 40606514). In a study using 2 soils, 83-100% of the unaged parent was collected in the leachate. In a second study with 4 soils, <0.2-83% of the unaged parent and 89-95% of unaged residues were collected in the leachate. While aging reduces the mobility of oxamyl residues, significant amounts were still detected; 67% of 7-day aged residues, and 37% of 18-day aged residues, compared to 95% in unaged residues (12-inch long column). Oxime and DMOA were found in both the unaged and aged residue leachate. In an 18-inch long column study, 61-63% of the applied radioactivity of oxamyl residues aged 30 days were recovered in the leachate.

Oxamyl has a relatively low partial vapor pressure (3.8×10^{-7} torr at 25°C; MRID 42526101) and is soluble in water up to 2.8×10^{5} mg/L at 20°C (MRID 40499702). This indicates that the compound will not readily volatilize from soil or water or precipitate from water. Oxamyl has a low n-octanol-water partition coefficient ($K_{OW} = 0.36$) and, therefore, is not expected to bioaccumulate (MRID 40499702).

3.1.3. Field Dissipation

In the field, half of the applied oxamyl dissipated from the surface in less than 3 weeks (DT_{50} range of 3 to 19 days) in studies from Florida, California and Washington (MRID 41573201; 41963901). When both oxamyl and oxime residues are considered, the combined DT_{50} values range from 4 to 39 days. Field dissipation studies (including a recently reviewed study conducted in Mississippi) show that both oxamyl and oxime leach through the soil, confirming that these residues have a low affinity for adsorption and are mobile in soil (Acc. No. 40494; 145302; 149231; MRID 41573201; 41963901; 45045304). Oxamyl residues reached the lowest sampled soil depth within several weeks of application in a variety of crops and sites.

3.1.4. Residues of Concern

Oxamyl alone is the residue of concern in drinking water that is included in this assessment. The major degradates identified in the IRED, oxime and DMOA, are not considered in the IRED to be of toxicological concern (USEPA, 2000). The remaining major degradates of oxamyl, DMCF and DMEA, are possible degradates of oxime and are not structurally similar to oxamyl parent. Therefore, they are not considered of toxicological concern.

3.2. Drinking Water Exposure Modeling

Estimated drinking water concentrations (EDWCs) were generated using EFED's standard suite of models. The proposed sugar beet use and the currently registered maximum and major use patterns (cotton, potato, mint, dry onion, tomato, citrus, apple, carrot, pepper, and cucumber) were assessed.

3.2.1. Models

The models, Pesticide Root Zone Model (PRZM v3.12.2; May 12, 2005; Carousel *et al.*, undated) linked with EXposure Analysis Modeling System (EXAMS v2.98.4.6; Apr. 25, 2005; Burns, 2004) via the PRZM/EXAMS model shell (PE v5.0, Nov. 15, 2006), *i.e.*, PRZM/EXAMS, and Screening Concentration in Ground Water (SCI-GROW v2.3, Jul. 29, 2003), were run to estimate screening-level exposure of drinking water sources to oxamyl. The PRZM model simulates pesticide movement and transformation on and across the agricultural field resulting from crop applications. The EXAMS model simulates pesticide loading via runoff, erosion, and spray drift assuming a standard watershed of 172.8 ha that drains into an adjacent standard drinking water index reservoir of 5.26 ha, an average depth of 2.74 m. A more detailed description of the index reservoir watershed can be found in Jones *et al.*, 1998. The coupled PRZM/EXAMS model and users manuals may be downloaded from the U.S. Environmental Protection Agency (EPA) Water Models web-page (USEPA, 2009a). Regional Percent Cropped Areas (PCA) that account for the maximum area within a watershed that may be planted with the modeled crop are applied to concentrations predicted by PRZM/EXAMS.

SCI-GROW is a regression model used as a screening tool to estimate pesticide concentrations found in ground water used as drinking water. SCI-GROW was developed by fitting a linear model to ground water concentrations with the Relative Index of Leaching

Potential (RILP) as the independent variable. Ground water concentrations were taken from 90-day average high concentrations from Prospective Ground Water studies. The RILP is a function of aerobic soil metabolism and the soil-water partition coefficient. The output of SCI-GROW represents the concentration of oxamyl residue that might be expected in shallow unconfined aquifers under sandy soils, which is representative of the ground water most vulnerable to pesticide contamination and likely to serve as a drinking water source. The SCI-GROW model and user's manual may also be downloaded from the EPA Water Models web-page (USEPA, 2009a).

3.2.2. Input Parameters

3.2.2.1. Ground Water Modeling

The model input parameters used in SCI-GROW to estimate a screening level of exposure in ground water are listed in **Table 5**. Because the model reflects total annual application rates and is insensitive to single applications rates and numbers of application, all uses were modeled at 1 pound of active ingredient per acre (lb a.i./A) times the number of applications per year required to achieve the labeled maximum annual application rate, regardless of how the use patterns appear on current and proposed labels. Where labeled uses are restricted or labeled use rates change according to geographical area, the modeled maximum use pattern reflects the maximum application rate for all regions. For example, the use on ginger root is only allowed in Hawaii and the use rate on potatoes is 6 lbs a.i./A/season in the Northeast and Mid-Atlantic states and 9 lbs a.i./season/year elsewhere. Modeled maximum use patterns, therefore, reflect use in Hawaii for ginger root and use in states other than those in the Northeast and the Mid-Atlantic for potatoes.

Table 5. SCI-GROW input parameters for oxamyl.

Input Parameter	Value	Comment	Source
Application Rate (lbs a.i./A)	1	Output reflects total applied per year and is not sensitive to how many single applications occur.	Proposed and current labels
Applications per Year	Ginger root: 10 Potatoes: 9 Carrots, tomatoes, non-bearing fruit: 8 Citrus, cucumbers, peppers: 6 Onions, sugar beets, mint: 4 Cotton: 3 Apples: 2		
Organic Carbon Partition Coefficient (K_{OC}) (L/kg$_{OC}$)	10	Represents the lowest K_{OC} value, which is used when variation is greater than three-fold.	MRID 46237301
Aerobic Soil Metabolism Half-life (days)	11	Represents the median of six half-lives (range 2.9 – 112).	Acc. No. 63012 MRID 42820001 MRID 45176602

The lowest organic carbon partition coefficient (K_{OC}) value reported in MRID 46237301 was used for the K_{OC} model input because reported values have more than three-fold variation. K_{OC} values from the open literature were not used in exposure modeling because of uncertainty in the robustness of the studies. The median of the six acceptable aerobic soil metabolism half-lives was used for the aerobic soil metabolism half-life model input.

3.2.2.2. Surface Water Modeling

Chemical Inputs

The general chemical and environmental fate data for oxamyl listed in **Table 4** were used for generating model input parameters for PRZM and EXAMS (listed in **Table 6**). These inputs were determined in accordance with current divisional guidance (USEPA, 2002). This guidance indicates that the hydrolysis rate at pH 7 (half-life of 8.0 days for oxamyl) should be modeled, which was done for exposure estimation. However, oxamyl is relatively stable to hydrolysis in acidic water bodies. Therefore, exposure estimates in acidic water bodies are expected to be slightly higher than those modeled in this assessment.

Table 6. PRZM and EXAMS Chemical Input Parameters for Oxamyl.

Input Parameter	Value	Comment	Source (MRID)
Molecular Mass (g/mol)	219	Product chemistry data	40499702
Vapor Pressure (torr)	3.8×10^{-7}	Product chemistry data	42526101
Solubility in Water (mg/L)	2.8×10^{5}	Product chemistry data	40499702
Organic Carbon Partition Coefficient (K_{OC}) (L/kg_{OC})	35	Represents the average K_{OC}.	46237301
Aerobic Soil Metabolism Half-life (days)	52	Represents the upper 90% confidence bound on the mean of six half-lives.	Acc. No. 63012 42820001 45176602
Aerobic Aquatic Metabolism Half-life (days)	6.6	Represents the upper 90% confidence bound on the mean of two half-lives adjusted for hydrolysis at pH 7.	45045305
Anaerobic Aquatic Metabolism Half-life (days)	0	No data; assumed stable. Aqueous dissipation will be dominated by hydrolysis.	Not applicable
Hydrolysis Half-life (days)	8.0	Half-life at pH 7	40606516
Aqueous Photolysis Half-life (days)	14	Represents the maximum environmental phototransformation half-life.	40606515; 41058801

Chemical property input values were chosen in accordance with current input parameter guidance (USEPA, 2002b). The upper 90% confidence bound on the mean was selected for the aerobic soil metabolism half-life (52 days) and aerobic aquatic metabolism half-life (6.6 days). The pH 7 hydrolysis half-life (8 days) was used and since hydrolysis is a dominant process in aqueous environments and since there are no submitted data for anaerobic aquatic metabolism, it was assumed stable. The average K_{OC} value (35 L/kg_{oc}) was selected for modeling.

Use Pattern Inputs

The model input parameters used in PRZM to simulate oxamyl application and crop management practices are provided in **Table 7**. These use patterns are those on current (EPA Reg. No. 352-532 and 352-372) or proposed (EPA Reg. No. 352-532) labels that produce the maximum estimated aquatic exposure for each use. Application timing of oxamyl is related to various pest pressures. For the purposes of this assessment, it was assumed that at-plant applications were made two weeks prior to crop emergence and post-emergence applications were made two weeks after crop emergence, as specified in the standard scenarios. Initial application dates were selected in order to reflect labeled crop timing for applications, consistent with the crop timing set by the model scenarios and with crop-profile information provided by the U.S. Department of Agriculture (USDA, 2008).

For the initial Tier II exposure assessment, single model scenarios were selected for each use to produce high-end exposure estimates at a national level. For this refined assessment, multiple scenarios were modeled, if available, for each use, in order to provide exposure estimates relevant to regions of the U.S. These regions are large in most cases because the number of scenarios per use is small, which requires the few scenarios to act as surrogates for large areas of the U.S.

Table 7. PRZM Input Parameters Describing Maximum Oxamyl Use Patterns.

Uses	Scenario	Date of Initial App.	App. Rate (lbs a.i./A)	App. per Year	App. Interval (days)	CAM Input	IPSCND Input	Application Efficiency/ Spray Drift
Apple (bearing fruit)	PA apple STD	Apr 1	2.0	1	N/A	2	3	0.99/0.064
	NC apple STD							
	OR apple STD							
	CA fruit STD							
Carrot	CA row crop RLF	Jan 15	4.0, 1.0[a]	5	5[b]	2	1	0.99/0.064
	STX vegetable NMC	Oct 15						
	PA vegetable NMC	May 24						
	FL carrot STD	Oct 30						
Citrus (bearing fruit)	CA citrus STD	Oct 1	2.0	3	30	2	3	0.99/0.064
	STX grapefruit NMC	Apr 1	1.0	6	15	2	3	0.95/0.16
	FL citrus STD							
Cotton	CA cotton STD	Sep 20	1.0	3	6	2	1	0.95/0.16
	NC cotton STD	Aug 1	0.50	6				
	TX cotton OP	Sep 15						
	STX cotton NMC	Jul 20						
	MS cotton STD	Sep 7						

Table 7. PRZM Input Parameters Describing Maximum Oxamyl Use Patterns.								
Uses	**Scenario**	**Date of Initial App.**	**App. Rate (lbs a.i./A)**	**App. per Year**	**App. Interval (days)**	**CAM Input**	**IPSCND Input**	**Application Efficiency/ Spray Drift**
Cucumber	CA melons RLF	May 16	1.0	6	7	2	1	0.95/0.16
	STX melon NMC	Feb 1						
	MO melon STD	Apr 10						
	MI melon STD	Apr 30						
	FL cucumber STD	Oct 16						
	NJ melon STD	May 1						
Dry onion	CA onion STD	Jan 16	2.0, 0.5[c]	3	14	2	1	0.99/0.064
	WA onion NMC	Jun 1	4.0, 0.5[d]	2	14[b]			
	PA vegetable NMC	Apr 26			14			
	GA onion STD	Sep 1						
Mint	OR mint STD	Apr 15	2.0	2	21	2	1	0.99/0.064
Non-bearing fruit	CA fruit STD	Mar 1	1.0	8	7	2	3	0.95/0.16
	CA citrus STD							
	FL citrus STD							
	GA peach STD							
	MI cherry STD	May 1						
	NC apple STD	Apr 1						
	OR apple STD							
	Orchard BSS							
	WA orchard NMC							
	PA apple STD	Apr 16						
	STX grapefruit NMC	Mar 16						
Pepper	CA row crop RLF	Jan 1	1.0	6	7	2	1	0.95/0.16
	STX vegetable NMC	Oct 1						
	PA vegetable NMC	May 10						
	FL pepper STD	Sep 1						
Potato	CA potato RLF	Feb 2	4.0, 1.0[e]	6	30, 5[e]	2	1	0.99/0.064
	IDN potato STD	May 18						
	WA potato NMC	Apr 17						
	FL potato NMC	Jan 17	1.0, 4.0[f]		5, 315[f]			
	ME potato STD	Jun 15	1.0		5			0.95/0.16
Sugar beet	CA sugar beet OP	Apr 1	2.0	2	10	2	1	0.99/0.064
	MN sugar beet STD	Jun 18						
Tomato	CA tomato STD	Apr 1	1.0	8	5	2	1	0.95/0.16
	STX vegetable NMC	Nov 15						
	FL tomato STD	Mar 24						

Table 7. PRZM Input Parameters Describing Maximum Oxamyl Use Patterns.								
Uses	Scenario	Date of Initial App.	App. Rate (lbs a.i./A)	App. per Year	App. Interval (days)	CAM Input	IPSCND Input	Application Efficiency/ Spray Drift
	PA tomato STD	Aug 15						

a The initial application is 4.0 lbs a.i./A, followed by 4 applications at 1.0 lb a.i./A to total 8.0 lbs a.i./A/season.
b Interval is assumed in the absence of a labeled value.
c The initial 2 applications are 2.0 lbs a.i./A, followed by 1 application at 0.5 lbs a.i./A to total 4.5 lbs a.i./A/season.
d The initial application is 4.0 lbs a.i./A, followed by 1 application at 0.5 lbs a.i./A to total 4.5 lbs a.i./A/season.
e The initial application is 4.0 lbs a.i./A, followed 30 days later by 5 applications at 1.0 lb a.i./A, 5 days apart.
f Because the initial application begins in December, this use pattern was modeled with 5 applications at 1.0 lb a.i./A, 5 days apart, beginning January 17th and followed 315 days later, in December, by the next season's initial application of 4.0 lbs a.i./A.

Although ginger root has the maximum allowed seasonal rate (10 lbs a.i./A/season), it is restricted to use in Hawaii and has a large reapplication window of 30-60 days. Oxamyl is short-lived and not expected to persist between applications made at this interval. Also, model scenarios do not exist for Hawaii and an appropriate surrogate scenario is not identified. Therefore, use on ginger root was not modeled for assessment of exposure to surface water.

Although uses of oxamyl are seasonally limited, whereas model inputs must be annually limited, all modeled uses of oxamyl have only one season per year. Therefore, seasonal use patterns were modeled as annual use patterns. Selected uses of oxamyl that were not modeled, such as celery, have multiple seasons per year. The possibility of multiple seasons of crops, single or rotated, per year adds uncertainty to this analysis.

Regional PCA Refinement

The exposure estimates from PRZM/EXAMS were multiplied by regional percent cropped area factors (PCA) for HUC-2 watershed basins of the U.S. in order to account for the highest extent of watershed in the regions on which agricultural crops are grown (Effland *et al.*, 1999). **Figure 3** displays the 18 HUC-2 watershed basins of the contiguous U.S. for which regional PCA factors are calculated.

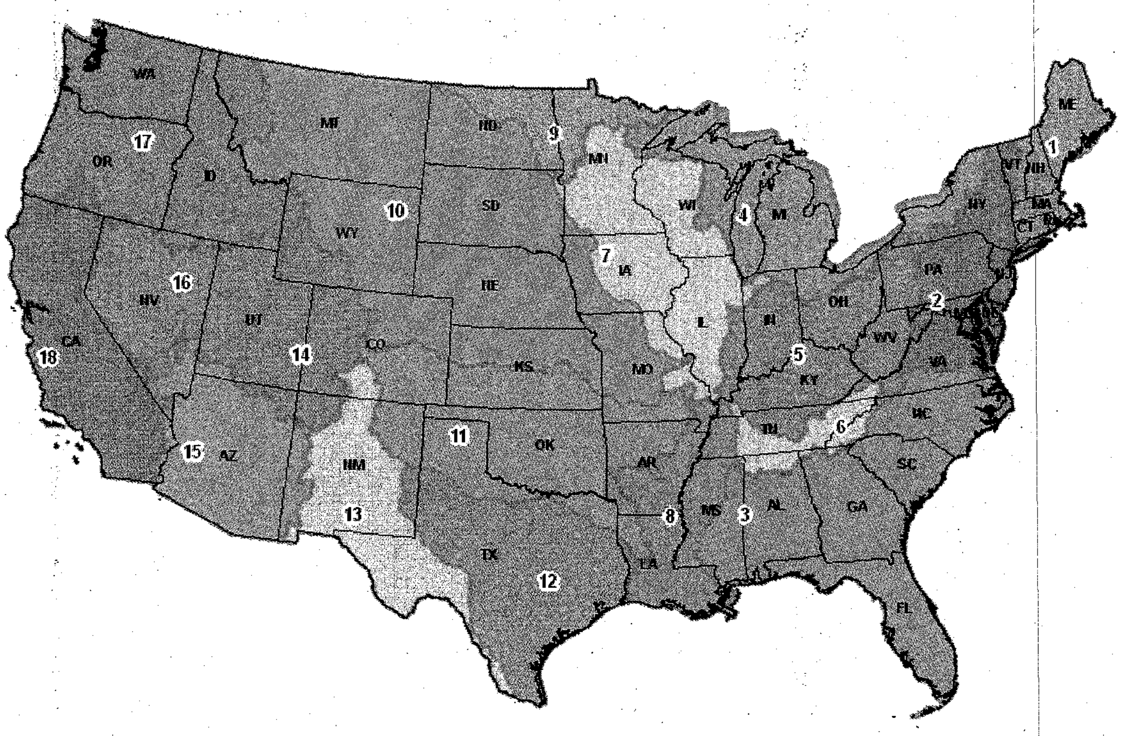


Figure 3. The Eighteen HUC-2 Watershed Basins of the Contiguous United States.

The first step in this process was to use 2002 AgCensus data (*i.e*, dot-density maps) to ascertain the states in which the modeled crops are grown at a density sufficient to be mapped (USDA, 2008a). These data and the geographic limitations imposed by the labels were used to tabulate states per PCA region where oxamyl might be applied to the modeled uses (**Table B1, Appendix B**). The second step was to assign a PRZM/EXAMS scenario for modeling each use-PCA region combination where oxamyl might be applied (**Table B2, Appendix B**). The strategy for assigning surrogate scenarios was to attempt to use current scenarios to represent areas of similar meteorological and agronomic conditions. For uses where there are limited numbers of currently approved scenarios, current scenarios representing areas west of the Rockies were used to represent large regions west of the Rockies that were generally to the south and/or east of the scenario location. Similarly, current scenarios representing areas east of the Rockies were used to represent large regions east of the Rockies that were generally to the south and/or west of the scenario location. However, scenarios representing areas of South Texas or Florida were used to represent the HUC-2 watershed basin in which they are located as well as watershed basins further north where alternative scenarios were less representative.

Following the assignment of model scenarios to each use-PCA region combination, the modeling was conducted and the regional PCA-adjusted 1-in-10-year peak EDWCs were tabulated for each combination of use and PCA region (**Table B3, Appendix B**), as discussed in the Modeling Results section below.

3.2.3. Modeling Results

Proposed and current use patterns were modeled for surface water and ground water exposure estimates, as described above. The use patterns that yielded the maximum surface water and ground water EDWCs listed in the tables below for use in drinking water exposure estimation were carrots and ginger root, respectively. Acute EDWCs ranged up to 516 µg/L for surface water and up to 1.3 µg/L for ground water. Sample model input/output data for these estimates are attached in **Appendix D**.

3.2.3.1. Ground Water Results

Tier I acute and chronic exposure estimates in ground water from SCI-GROW ranged up to 1.3 µg/L (**Table 8**). Use on ginger root resulted in the maximum exposure estimates in shallow ground water (1.3 µg/L). Further refinement of ground water modeling was not pursued because HED indicated that this maximum exposure estimate did not result in dietary exceedances of levels of concern (personal communication with Sheila Piper, Nov. 19, 2008).

Table 8. Tier I estimated drinking water concentrations (EDWCs) in ground water resulting from application of oxamyl.

Use	Maximum annual application rate	1-in-10 year peak (µg/L)	1-in-10 year annual mean (µg/L)	30- year mean (µg/L)
Ginger root	10 lbs a.i./A/year	**1.3**	**1.3**	**<1.3**
Potatoes	9 lbs a.i./A/year	1.1	1.1	<1.1
Carrots, Tomatoes, Non-bearing fruit	8 lbs a.i./A/year	1.0	1.0	<1.0
Citrus, Cucumbers, Peppers	6 lbs a.i./A/year	0.75	0.75	<0.75
Mint, Onions, Sugar beets	4 lbs a.i./A/year	0.50	0.50	<0.50
Cotton	3 lbs a.i./A/year	0.38	0.38	<0.38
Apples	2 lbs a.i./A/year	0.25	0.25	<0.25

3.2.3.2. Surface Water Results

Regional PCA-adjusted acute and chronic exposure estimates in surface water drinking water sources from PRZM/EXAMS are listed in **Table 9**. Exposure estimates representing a 1-in-10-year peak ranged from 116 to 334 µg/L for the modeled use patterns, including the proposed use on sugar beets, but excluding the current uses on mint and fruit-bearing apples and citrus, for which exposure estimates ranged 12 to 70 µg/L. Use on carrots in the Lower Mississippi watershed basin resulted in the highest estimated peak exposure (1-in-10-year peak of 334 µg/L). These exposure estimates are adjusted by the highest regional PCA applicable to the use.

Table 9. Tier II estimated drinking water concentrations (EDWCs) adjusted by maximum PCAs resulting from application of oxamyl.					
Use (modeled rate)	**PCA[a]**	**PRZM Scenario**	**1-in-10 year acute (µg/L)**	**1-in-10 year chronic (µg/L)**	**30- year mean (µg/L)**
Apples (2 lbs a.i./A/year)	87%	PA apple	27	0.6	0.3
Carrots (8 lbs a.i./A/year)	85%	STX vegetable	**334**	**7.3**	2.9
Citrus (6 lbs a.i./A/year)	38%	FL citrus	70	1.6	1.0
Cotton (3 lbs a.i./A/year)	85%	MS cotton	123	2.4	1.2
Cucumbers (6 lbs a.i./A/year)	67%	STX melon	147	3.3	1.8
Mint (4 lbs a.i./A/year)	87%	OR mint	12	0.4	0.2
Non-bearing fruit (8 lbs a.i./A/year)	38%	FL citrus	124	3.1	1.5
Onions (4 lbs a.i./A/year)	67%	GA onion	163	2.6	1.3
Peppers (6 lbs a.i./A/year)	85%	STX vegetable	256	4.7	2.2
Potatoes (9 lbs a.i./A/year)	85%	FL potato	231	5.9	**3.7**
Sugar beets (4 lbs a.i./A/year)	87%	MN sugar beets	116	2.0	0.9
Tomatoes (8 lbs a.i./A/year)	85%	PA tomato	208	4.5	2.4

a The PCA is the highest regional PCA applicable to the use. EDWCs are adjusted by these maximum regional PCAs.

Regional PCA Refinement

As stated above, regional PCA-adjusted 1-in-10-year peak EDWCs were tabulated for each combination of use and HUC-2 watershed basin **(Table B3, Appendix B)**. A preliminary table of these exposure estimates was delivered to HED in October, 2008 (DP barcode 357440; USEPA 2008). Based on this information, HED indicated in November, 2008 that dietary levels of concern (for food plus water and accounting for number of eating occasions per day) are generally exceeded when EDWC time series are represented by a 1-in-10-year peak value near or above 80 µg/L (personal communication with Sheila Piper, Nov. 19, 2008). Therefore, the values on **Table B3** that exceed this value have potential to result in exceedances of dietary levels of concern. Using this information, the currently labeled uses on mint and fruit-bearing apples and citrus are not expected to result in EDWCs that exceed this value; the remaining modeled uses may result in EDWCs that exceed this value in some parts of the U.S. Also, concentrations in the New England region (Major Basin 1) or any region west of the Continental Divide are below this value. HED analysis is necessary to accurately estimate dietary risk from these uses.

Exposure Characterization for "Actual" Rates

In order to characterize reductions in exposure estimates resulting from potential changes to the proposed and currently labeled use patterns, usage data were requested from the Biological and Economic Analysis Division (BEAD) for the uses (carrots, peppers, oranges, grapefruit, lemons, cotton, cucumber, onions, sugar beets, and tomatoes) and regions where EDWCs exceeded 80 µg/L. BEAD provided the requested usage data at the state-level and at the application level, such as per crop stage, where possible using data from 2003 to 2007 (DP barcode 359723; USEPA, 2009). Application rate distributions based on data from 1998 to 2007 were also provided. Based on these data, "actual" use patterns were identified **(Table 3)** for modeling with PRZM/EXAMS to estimate their resulting exposure and to explore whether the exposure would remain at levels expected to exceed 80 µg/L.

Table 10 lists the model input parameters used in PRZM to simulate the "actual" use patterns that were identified in **Table 3** to represent more typical usage of oxamyl than the maximum use patterns, many of which previously resulted in potential dietary risk exceedances. These use patterns were also modeled using the chemical input parameters listed in **Table 6.**

Table 10. PRZM Input Parameters Describing Less-Than-Maximum Oxamyl Use Patterns.

Uses	Scenario	Date of Initial App.	App. Rate (lbs a.i./A)	App. per Year	App. Interval (days)	CAM Input	IPSCND Input	Application Efficiency/ Spray Drift
Carrot	STX vegetable NMC	Oct 15	1.0	2	5	2	1	0.99/0.064
	PA vegetable NMC	May 24						
	FL carrot STD	Oct 30						
Cotton	TX cotton OP	Sep 15	0.50	2	6	2	1	0.95/0.16
	STX cotton NMC	Jul 20						
	MS cotton STD	Sep 7						
Cucumber	STX melon NMC	Feb 1	1.0	2	7	2	1	0.95/0.16
	FL cucumber STD	Oct 16						
Dry onion	GA onion STD	Sep 1	0.5	7	5	2	1	0.95/0.16
Non-bearing fruit	FL citrus STD	Mar 1	1.0	2	7	2	3	0.95/0.16
	PA apple STD	Apr 16						
	Orchard BSS	Apr 1						
Pepper	STX vegetable NMC	Oct 1	1.0	2	7	2	1	0.95/0.16
Potato	FL potato NMC	Jan 1	1.5	2	7	2	1	0.99/0.064
Sugar beet[a]	MN sugar beet STD	Jun 18	1.5	2	10	2	1	0.99/0.064
Tomato	STX vegetable NMC	Nov 15	1.5	3	5	2	1	0.99/0.064
	FL tomato STD	Mar 24						
	PA tomato STD	Aug 15						

a Usage data for other row crops were used to formulate a hypothetical use pattern for the proposed use on sugar beets.

The resulting regional PCA-adjusted 1-in-10-year peak exposure estimates in surface water drinking water sources are listed in **Table 11** for the use-watershed region combinations that exceeded 80 µg/L for the maximum labeled use patterns (cells with highlighted values in **Table B3, Appendix B**). These results indicate that "actual" application patterns reduce most exposure estimates below target values. At the modeled "actual" application patterns for uses on cotton, cucumbers, dry onions, and non-bearing fruit, estimated drinking water exposure from any major basin does not exceed 80 µg/L. However, use on carrots at "actual" application rates exceeds 80 µg/L in the Lower Mississippi, Arkansas, and Texas Gulf watershed regions. Use on tomatoes at "actual" application rates exceeds 80 µg/L in six watershed regions. "Actual" application rates used on peppers and potatoes exceed but are close to 80 µg/L in the Lower

Mississippi and Arkansas watershed regions. Likewise, use on sugar beets at an application rate less than that proposed results in drinking water exposure estimates in the Upper Mississippi, Souris, and Missouri watershed regions that exceed but are close to 80 µg/L.

Table 11. EDWCs (µg/L) from "actual" use patterns by use and by regional PCA specific to each major watershed basin where that use may occur (values >80 µg/L in bold).

Major Basin #	Carrot	Cotton	Cucumber	Dry onion	Non-bearing fruit	Pepper	Potato	Sugar beet	Tomato
2									**86**
3	56		33		45		39		72
4	35							77	**144**
5	38				21				**153**
6									71
7	39							**85**	**159**
8	**140**	47				**87**	**88**		**125**
9	38							**83**	
10	40							**87**	
11	**132**	56			28	**82**	**83**		
12	**111**	55	45	32	23	69	69		**98**
13	46					29			

Table 12 lists resulting regional PCA-adjusted 1-in-10-year peak exposure estimates in surface water drinking water sources for the use-watershed region combinations that exceeded 80 µg/L when "actual" use patterns were modeled (cells with highlighted values in **Table 11**), assuming a lower, arbitrarily chosen application rate for each use of 1 lb a.i./A applied once per year. At this application rate, drinking water exposure in all regions of the contiguous United States is estimated at well below 80 µg/L. As mentioned above, HED analysis is necessary to accurately estimate dietary risk from these uses at any application rate.

Table 12. EDWCs (µg/L) by use and by regional PCA specific to each major watershed basin where that use may occur, assuming a low use pattern of 1 lb a.i./A applied once per year.

Major Basin #	Carrot	Pepper	Potato	Sugar beet	Tomato
2					21
4					35
5					37
7				25	38
8	58	52	33		23
9				24	
10				25	
11	54	49	31		
12	45				18

3.3. Monitoring Data

Ground Water Monitoring

The 2000 oxamyl IRED provided a comprehensive summary of a number of monitoring studies (USEPA, 2000). According to the U.S. EPA Pesticides in Groundwater Database (USEPA, 1992), oxamyl was detected at concentrations ranging from 0.01 to 395 μg/L in 904 of 23,305 discrete wells monitored between 1971 and 1991 in ten states. The majority of detections were in Suffolk County (Long Island), New York, which had 1,620 detections in 49,022 samples (*i.e.*, detections at 897 of 20,955 wells), with five detections (at three wells) above 200 μg/L, including the maximum reported concentration, 395 μg/L.

In 1982, oxamyl was voluntarily restricted from use in Suffolk and Nassau Counties, New York (Trent, 2009). However, continued non-targeted monitoring of oxamyl in public and private wells conducted by the County of Suffolk indicates that the compound has continued to be detected in multiple wells every year since 1982, with the exception of 1996. Maximum concentrations detected were typically in the tens of μg/L in the 1980's, in the single-digit μg/L in the 1990's, and are currently typically less than one μg/L (County of Suffolk, 2009; Trent, 2009).

Separate ground water monitoring conducted between October 1, 1997 and March 31, 1998 in 898 shallow wells thought to be vulnerable to pesticide contamination in areas of Nassau and Suffolk Counties (Long Island), New York, indicated that oxamyl was detected eight times at concentrations up to 11.0 μg/L (NYS DEC, 2009). Also, in a non-guideline ground water monitoring study in New York, oxamyl was detected at concentrations of 5.0-5.4 μg/L in three shallow wells (9-12 feet deep) within 10 feet of a treated potato field in the same season of application, but was not detected in later samples (Acc. No. 96623).

The STORET database reports detections of oxamyl in 72 Arizona wells from 1990 to 1994 (USEPA, 2009b). Oxime was not listed as an analyte. Oxamyl concentrations ranged from less than the limit of detection (0.1-5.0 μg/L) to 24 μg/L. The NAWQA database reports 1,000 ground water sites across the nation analyzed for oxamyl and 174 ground water sites analyzed for oxime (USGS, 2009a). Reported concentrations of oxamyl in ground water ranged from 1 to 13 μg/L; detections of oxime were consistently reported at 1μg/L.

A small-scale prospective ground water (PGW) monitoring study was conducted for oxamyl and its oxime metabolite in Tarboro, North Carolina, in the coastal plain region (MRID 45591605). The study site has highly vulnerable soil and hydrogeologic characteristics. The soil at the site is a Tarboro loamy sand series, characterized by high drainage and negligible runoff. It has a sand to loamy sand texture with a layer of sandy loam to sandy clay loam at approximately two to four feet. The top foot of soil has an average organic matter content of 0.85% and a pH of 5.8. Below this, the organic matter content ranges from 0.10 to 0.23%, while the pH ranges from 4.3 to 7.9, generally lower at the top and increasing with depth. Based on undisturbed soil samples, the average field capacity is 9.6% in the top two feet and 15.1% from two to four feet and the bulk density at those depths averages 1.42 g/cm^3. The study site has a history of cotton, soybeans, peanuts, tobacco, and corn production. For this investigation, cotton was planted on May 22, 1997 and in July, a series of 5 ground broadcast applications of oxamyl were made on a 2 acre plot at 6 to 8 day intervals. The first two applications were at a rate of 0.5

lbs a.i./A and the rest at 1.0 lb/A. This represented the maximum labeled seasonal rate at the time using the minimum application intervals. A single application of a conservative bromide tracer was also applied. The cotton was harvested in November and peanuts planted the following summer. Precipitation was supplemented with overhead center pivot irrigation to bring the combined precipitation and irrigation to 56.41 inches, 120% of the historical mean precipitation.

Samples were collected at 8 days prior to and 35, 69, 96, 124, 160, 194, 222, 250, 285, 320, 348, 376, 411, 447, 474, 517, and 553 days after treatment from lysimeters at 3-ft, 6-ft, 9-ft, and 12-ft depths and from ground water wells at 12- to 21-ft depths. Oxamyl reached all shallow wells (12- to 17-ft), initially detected between days 124 and 194 after treatment. In one well, oxamyl persisted throughout the entire study period while in the others there were no detections beyond 376 days. The maximum concentration detected was 3.91 µg/L at 160 days after treatment. Oxamyl was detected in 5 of the deeper wells (17- to 21-ft), appearing by day 194 after treatment and persisting to day 378. The range of concentrations detected at this depth was 0.12 to 1.17 µg/L (**Figure 4**). Oxamyl oxime was detected at up to 4.55 µg/L (at 160 days after treatment) and results suggest that the degradate may persist for an extended period in ground water and subsurface soil horizons.

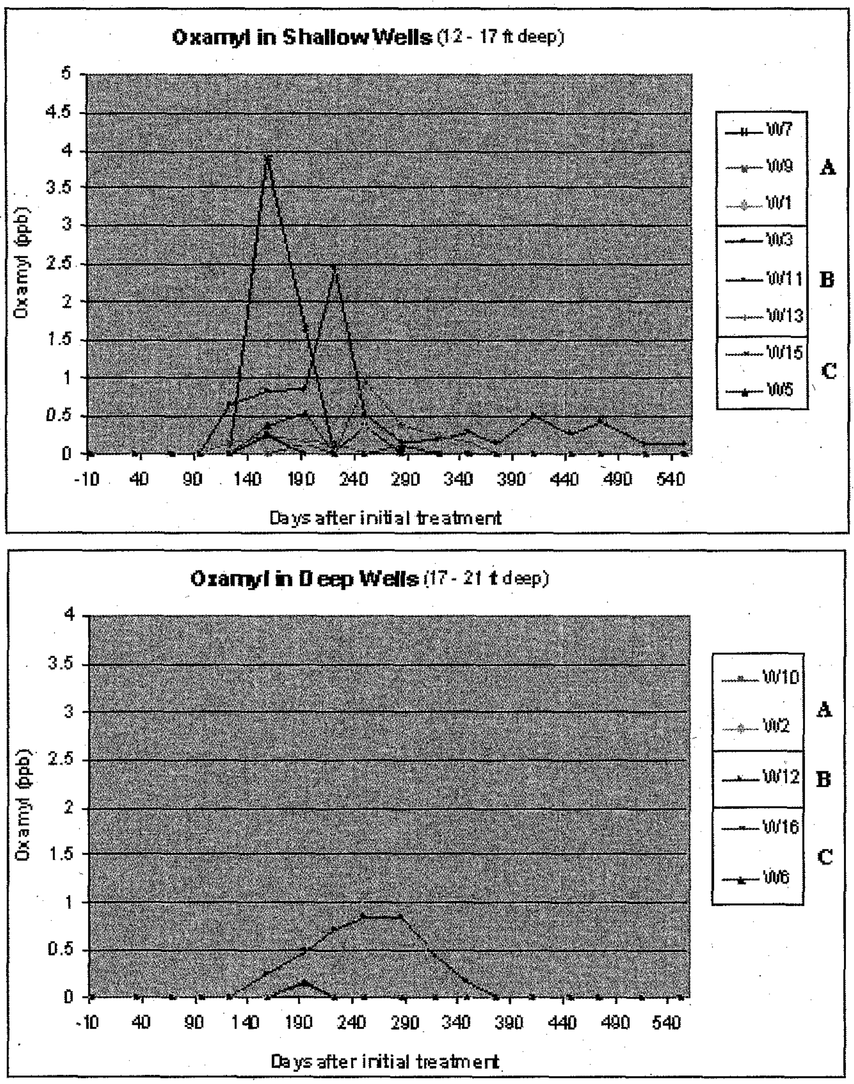


Figure 4. Oxamyl concentrations in shallow wells (top) and deep wells (bottom). Wells are grouped into subplots A, B, and C, where A is the most northern. Within each subplot, wells are listed upgradient to downgradient. Odd numbered shallow wells share a cluster.

A second small-scale prospective ground water (PGW) monitoring study was conducted for oxamyl and its oxime degradate on the Eastern Shore of Maryland in Hurlock (MRID 45591606). The study site represents vulnerable soil and hydrogeologic conditions. The soil at the site is a Fort Mott loamy sand series, characterized by moderately rapid permeability. The top six inches of soil ranged in pH from 5.1 to 7.6. For this investigation, tomatoes were planted during the first growing season. In June, a series of 8 ground broadcast applications of oxamyl were made on a 2 acre plot at 6 to 8 day intervals. The applications were at a rate of 1 lb a.i./A, seven days apart. This represents the maximum labeled rate on tomatoes using the minimum application intervals. A single application of a conservative bromide tracer was subsequently applied. Precipitation was supplemented with overhead center pivot irrigation to bring the combined precipitation and irrigation to 132 inches, 107% of the historical mean precipitation.

Samples were collected at 6 days prior to and 6, 13, 20, 27, 34, 41, 48, 55, 62, 76, 104, 140, 168, 196, 231, 261, 287, 317, 343, 379, 413, 442, 469, 504, 538, 561, 597, 629, 651, 686, 714, 749, 777, 806, 833, 863, 898, 926, 952, 986, and 1023 days after treatment from lysimeters at 3-ft, 6-ft, 9-ft, and 12-ft depths and from ground water wells at 12- to 22-ft depths. Oxamyl was detected in ground water wells at 41 days and 317 to 898 days after treatment. Oxime was detected in ground water wells intermittently from 104 to 898 days after treatment (not all samples were analyzed at each sampling event). Oxamyl and oxime exceeded the limit of quantitation (1 μg/L) in two shallow wells, at up to 1.5 μg/L from 504 through 561 days after treatment. These results suggest that oxamyl and oxime may persist for an extended period in ground water.

Surface Water Monitoring

The 2007 Revised N-Methyl Carbamate Cumulative Risk Assessment provided a summary of a number of monitoring studies (USEPA, 2007). The United States Department of Agriculture Pesticide Data Program (PDP) sampled finished drinking water from 2001 to 2003 at 21-35 sites across the nation and expanded the sampling in 2004 to include pair sampling of finished and untreated samples at different locations. In 2001, oxamyl was detected in finished drinking water at four of ten sampled locations in California at 51 to 79 ng/L. Oxamyl was not detected in 2002 or 2003.

The STORET database reports analyses of oxamyl at hundreds of sites across the nation (USEPA, 2009b). Oxime was not listed as an analyte. Oxamyl concentrations ranged from less than the limit of detection (0.1-6.9 μg/L) to 1 μg/L in surface water and were 4.8 to 6300 μg/kg in estuarine sediment analyzed in Florida. The NAWQA database reports oxamyl and oxime detections at 966 and 33 surface water sites across the nation, respectively (USGS, 2009a). Reported concentrations of oxamyl ranged from 1 to 98 μg/L (11 detections were >80 μg/L); detections of oxime ranged from 1 to 29 μg/L.

The California Department of Pesticide Regulation (CDPR) Surface Water Database indicates that oxamyl was analyzed at 183 surface water sites in California at various times from February 1991 to October 2006 (CDPR, 2009). Degradates of oxamyl were not analyzed. Oxamyl was detected at 11 of those sites at concentrations ranging from less than the level of quantitation (0.1-0.5 μg/L) to 2.8 μg/L. Detections occurred in the San Jose River and its tributaries (Stanislaus and Merced counties) in April of 1991, 1992, and 2002 and in the Pajaro River and its tributaries (Santa Cruz and Monterey counties) on December 13, 1994. The highest detection of 2.8 μg/L occurred in a drainage ditch connected to the Pajaro River. Sites with detections were often reanalyzed for oxamyl within a few weeks to a few months, resulting in no detections. Study authors concluded that the presence of oxamyl likely correlates with upslope usage and that residues dissipate in flowing water bodies.

Monitoring Discussion

The available monitoring data suggest that oxamyl may be detected in both ground water and surface water at up to 100-400 μg/L in vulnerable areas. Although oxamyl was not detected in most samples, the surface water monitoring studies did not target oxamyl use areas or times of known oxamyl use and, thus, may not necessarily reflect potential peak oxamyl concentrations that may occur in surface waters when runoff events occur shortly after oxamyl is applied. However, the data suggest that oxamyl is not likely to be found in most surface waters and, when it is found, is not likely to persist.

Oxamyl is not expected to persist in neutral to alkaline aquatic environments. However, targeted and non-targeted ground water monitoring has detected concentrations as high as several hundred µg/L in vulnerable areas. More typical maximum concentrations observed in targeted studies are an order of magnitude less. Results of prospective ground water monitoring studies indicate that oxamyl may persist in some acidic ground water environments, which is supported by non-targeted monitoring conducted in Suffolk County, New York, where the compound has remained above detection limits (typically at <1 µg/L) since the compound was voluntarily restricted from use in 1982 (Trent, 2009).

These results are consistent with our understanding of the fate and transport properties of oxamyl. The highest detections of oxamyl in surface water in the monitoring data (up to 98 µg/L in surface water) are consistent with or within an order of magnitude of 1-in-10-year peak EDWCs of oxamyl in surface water (up to 334 µg/L) for uses on individual crops. The highest detections of oxamyl in ground water (up to 395 µg/L) are two orders of magnitude higher than screening estimated concentrations in ground water (up to 1.3 µg/L) and monitored concentrations from prospective ground water studies (up to 3.9 µg/L). However, high detections from most ground water monitoring studies are consistent with estimated values. Oxamyl may be relatively persistent in some acidic ground water environments. Changes in oxamyl detections due to label mitigations specified in the RED cannot yet be observed, as the RED mitigations were implemented in 2007, after which monitoring data are not yet available.

3.4. Drinking Water Treatment

According to the N-Methyl Carbamate Cumulative Risk Assessment, a review of available laboratory studies and monitoring data by EPA indicates that conventional water treatment processes such as coagulation, sedimentation, and conventional filtration will not reliably remove or transform the N-methyl carbamates such as oxamyl in drinking water sources (USEPA, 2007). Lime softening and activated carbon filtration can be effective in removing N-methyl carbamate pesticides such as oxamyl. Lime softening processes will break down oxamyl through alkaline-catalyzed hydrolysis. Sorption on activated carbon using granular activated carbon (GAC) or powdered activated carbon (PAC) appears to be at least partially effective in removing oxamyl from drinking water (percent removal ranges from 20 to 38% for oxamyl).

4. CONCLUSIONS

Tier II drinking water exposure estimates of oxamyl are represented by the maximum use patterns for oxamyl, carrots (for surface water) and ginger root (for ground water; **Tables 1, 8, and 9**). For the modeled uses, acute EDWCs ranged from 12 to 334 μg/L for surface water and from 0.25 to 1.3 μg/L for ground water. Chronic and cancer EDWCs ranged from 0.4 to 7.3 μg/L and from 0.02 to 3.7 μg/L, respectively, for surface water.

Monitoring data suggest that oxamyl may be detected in both ground water and surface water at up to 100-400 μg/L in vulnerable areas. However, maximum concentrations observed in most monitoring studies are typically lower. The data suggest that oxamyl is not likely to be found in most surface waters and, when it is found, is not likely to persist. The compound is not expected to persist in neutral to alkaline ground water. Prospective ground water monitoring and non-targeted monitoring indicate that oxamyl may persist in some acidic ground water environments.

The modeling assessment relied on maximum use patterns and regional PCA values. To the extent that actual use patterns are less than the labeled maximums and the location-specific PCAs are less than assumed in this assessment, actual environmental exposures could be lower. Modeled exposure estimates throughout this document are uncertain to the extent that the ranges of possible initial application dates were not modeled in order to characterize the exposure resulting from initial application occurring on the dates of most and least vulnerability and their relation to the selected date. The current and proposed label specifies application rates per crop/season. This assessment assumed that the seasonal rate was equivalent to the annual rate. If crops are rotated with others on which oxamyl is used, yearly rates could actually be higher than those assumed. Oxamyl, however, is typically short-lived, and is not expected to persist from season to season.

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Appendix A. Oxamyl use information.

Table A1. Summary of all use patterns for current and proposed oxamyl uses.[1]							
Use Pattern	**Current/ Proposed**	**Formula**	**Single App. Rate (lbs a.i./A)**	**Number of App.**	**Seasonal App. Rate (lbs a.i./A)[2]**	**App. Interval (days)**	**Application Method**
Cotton	Current (except AZ and CA)	Vydate® C-LV	0.13 to 0.5	8	3	6-8	Aerial Ground
	Current (AZ and CA)	Vydate® C-LV	0.25 to 1	8	3	6-8	Aerial Ground
	Current	Vydate® L	0.1 to 1	8	3	6-14	Aerial Ground
Peanuts	Current (except CA)	Vydate® C-LV	0.5	8	5	14	Aerial Ground
	Current (except CA)	Vydate® L	0.5	8	5	14-28	Aerial Ground
Potatoes	Current	Vydate® C-LV	0.25 to 1	8	6	5-7	Aerial Ground Chemigation
	Current (except Northeast and Mid-Atlantic)	Vydate® C-LV	2 to 4	NR	9	At Planting	In-Furrow
	Current	Vydate® L	0.2 to 4	8	4 (foliar only) – 9 (in-furrow + foliar)	5-7	In-Furrow Aerial Ground Chemigation
Sugar beets	Proposed (except CA)	Vydate® C-LV	1 to 2	NR	4	10	In-Furrow Injection Foliar
Tobacco	Current	Vydate® C-LV	2	NR	2	NR	Ground
	Current	Vydate® L	2	NR	2	NR	Ground
Apples	Current	Vydate® L	0.5 to 2	4	2	7-14	Aerial Ground
Apple Thinning	Current	Vydate® L	0.5 to 1	4	2	NR	Ground
Bananas, Plantains	Current	Vydate® L	1.2 to 2.4 mL a.i./seed	8	4 annually	60-120	Ground
Citrus	Current	Vydate® L	0.2 to 1	NR	6 OR (2 lbs. a.i./30 d) annually	14-42	Ground
	Current (CA)	Vydate® L	0.2 to 2	NR	NR	14-30	Chemigation
	Current (FL)	Vydate® L	1 to 2	3-6	NR	30-45	Chemigation
Nonbearing Fruit	Current	Vydate® L	0.5 to 4	NR	1 (Aerial) 8 (ground)	NR	Aerial Ground
	Current	Vydate® L	0.5 to 1	8	8	14-21	Ground
Pears	Current (except CA)	Vydate® L	1.5 to 2	1	2	First appear	NR

Table A1. Summary of all use patterns for current and proposed oxamyl uses.[1]							
Use Pattern	**Current/ Proposed**	**Formula**	**Single App. Rate (lbs a.i./A)**	**Number of App.**	**Seasonal App. Rate (lbs a.i./A)[2]**	**App. Interval (days)**	**Application Method**
Pineapple	Current (except CA)	Vydate® L	0.5 to 2	8	8 annually	14-56	Ground Chemigation
Carrots	Current (except CA)	Vydate® L	2 to 4	8	8	NR	Ground
	Current (except CA)	Vydate® L	0.5 to 1	3	8	14-21	Ground
Celery	Current (AZ, CA, FL only)	Vydate® L	0.5 to 1	8	6	5-7	Aerial Ground
	Current (FL, OH, PA, MI, TX only)	Vydate® L	1 to 4	NR	NR	14-21	Ground (incorporated)
	Current (CA only)	Vydate® L	1	NR	NR	21-30	Ground (furrow irrig./ incorporation)
Cucumber, Melon, Squash, Pumpkin	Current	Vydate® L	0.5 to 4	8	6	14 to 21	Aerial Ground
	Current	Vydate® L	0.5 to 1	8	6	10-21	Chemigation
Eggplant	Current	Vydate® L	0.5 to 1	8	6	7-21	Ground Chemigation
Garlic	Current (OR and CA only)	Vydate® L	0.5 to 4	8	4.5	7-21	Aerial Ground Chemigation
Ginger Root	Current (HI only)	Vydate® L	0.5 to 4	8	10	30-60	Ground
Onions	Current	Vydate® L	0.2 to 4	8	4.5	5-21	Aerial Ground (incorporated)
Peppers	Current	Vydate® L	0.5 to 1	8	6	7-14	Aerial Ground Chemigation
Sweet Potatoes	Current (except CA)	Vydate® L	2 to 4	NR	6	NR	Ground
Tomatoes	Current	Vydate® L	0.5 to 2	8	8	5-28	Aerial Ground Chemigation
Yams	Current	Vydate® L	0.5	8	4	14	Ground
Peppermint, Spearmint	Current	Vydate® L	1 to 2	2	4	21-28	Aerial Ground
Peanuts	Current (except CA)	Vydate® L	0.5	8	5	14-28	Aerial Ground

1 Single and annual application rate conversions were calculated based on the following formula information: Vydate® C-LV = Water soluble liquid, 42% a.i. by wt., 3.77 lbs. a.i./gallon; Vydate® L = Water soluble liquid, 24% a.i. by wt., 2 lbs. a.i./gallon.
2 Application rates were reported on a per growing season basis unless otherwise specified.
NR = Not reported.

Appendix B. PCA Region Tables.

Table B1. Intersection of states where crop is grown and states where oxamyl is labeled for use.

Major Basin #	Basin Name	Regional PCA	Apple	Carrot & Pepper	Citrus	Cotton	Cucumber	Dry onion	Mint	Non-bearing fruit	Potato	Sugar beet	Tomato
East of Eastern Divide													
1	New England	14	VT, NH, MA, CT, RI, ME	CT, RI, MA, VT, NH, ME			ME, MA, CT			VT, NH, MA, CT, RI, ME	ME, MA		CT, MA
2	Mid Atlantic	46	VA, MD, PA, NJ, NY, VT	VA, MD, DE, NJ, PA, NY, VT		MD, VA	NY, PA, NJ, DE, MD, VA			VA, MD, PA, NJ, NY, VT, DE	PA, MD, NJ, DE, RI		VA, MD, PA, NJ, NY
3	South Atlantic	38	AL, GA, SC, NC, VA	MS, AL, GA, FL, SC, NC, VA	FL	VA, NC, SC, GA, FL, AL, MS	NC, SC, GA, AL, FL			AL, GA, SC, NC, VA, FL, MS	NC, FL, AL		MS, AL, GA, FL, SC, NC
Mid-Continent (Mississippi River Basin)													
4	Great Lakes	77	WI, MI, IN, OH, NY	MI, WI, IN, OH, NY			MI, OH, NY	MI	MI, WI	WI, MI, IN, OH, NY	MI, WI, OH, NY	MI, OH	MI, OH, NY
5	Ohio	82	KY, IN, OH, VA, PA	TN, KY, IL, IN, OH, PA			IL, OH, KY			KY, IN, OH, VA, PA, WV	OH, PA		IN, OH, KY
6	Tennessee	38	TN, NC	AL, TN		TN, AL	TN, VA, NC			TN, NC			TN, NC
7	Upper Mississippi	85	MI, IA, WI, IL	MO, IL, IN, WI, IA, MN			IL, MN, WI		WI	MI, IA, WI, IL	MN, IA, WI, IL, SD	MN	MN, WI, IL
8	Lower Mississippi	85		LA, AR, MS, TN, MO	LA	AR, LA, MS, MO, TN	MO, LA			LA, AR, TN, MS, MO	MO		AR, LA
9	Souris	83		ND							MN, ND	ND, MN	
10	Missouri	87	NE, KS, IA, MO	KS, NE, CO, SD, IA			CO, MO		MT	NE, KS, IA, MO, MT	ND, MN, NE, CO, MO	ND, WY, MT, CO, NE	
11	Arkansas	80	OK, AR	OK, TX, CO, KS, MO, AR		KS, OK, TX, LA, AR	OK	TX		OK, AR	KS, TX		
12	Texas Gulf	67	TX	TX, NM	TX	TX	TX, NM	TX, NM		TX	TX		TX
13	Rio Grande	28	NM	CO, NM, TX		NM, TX		TX, NM		NM	CO		
West of Western Divide													
14	Upper Colorado	7	NM, CO	NM, CO						NM, CO	NM		CO
15	Lower Colorado	11	AZ	AZ, CA	AZ	AZ		CA		AZ	AZ		
16	Great Basin	28	UT	NV, CA, UT						UT	NV	UT	
17	Pacific Northwest	63	WA, OR, ID, MT	WA, OR, ID			WA, OR	OR, WA, ID	WA, OR, ID	WA, OR, ID, MT	ID, MN, OR, WA	WA,OR,ID	OR, WA
18	California	56	CA	CA (peppers only)	CA	CA	CA	CA, OR		CA, OR	CA, OR		CA

Table B2. Scenario assigned to each combination of use and major basin (HUC-2 region).												
Major Basin #	**Apple**	**Carrot**	**Citrus**	**Cotton**	**Cucumber**	**Dry onion**	**Mint**	**Non-bearing fruit**	**Pepper**	**Potato**	**Sugar beet**	**Tomato**
East of Eastern Divide												
1	PA apple STD	PA vegetable NMC			NJ melon STD			PA apple STD	PA vegetable NMC	ME potato STD		PA tomato STD
2	PA apple STD	PA vegetable NMC		NC cotton STD	NJ melon STD			PA apple STD	PA vegetable NMC	ME potato STD		PA tomato STD
3	NC apple STD	FL carrot STD	FL citrus STD	MS cotton STD	FL cucumber STD			FL citrus STD	FL pepper STD	FL potato NMC		FL tomato STD
Mid-Continent (Mississippi River Basin)												
4	PA apple STD	PA vegetable NMC			MI melon STD	PA vegetable NMC	OR mint STD	MI cherry STD	PA vegetable NMC	ME potato STD	MN sugar beet STD	PA tomato STD
5	PA apple STD	PA vegetable NMC			MO melon STD			PA apple STD	PA vegetable NMC	ME potato STD		PA tomato STD
6	NC apple STD	PA vegetable NMC		MS cotton STD	MO melon STD			NC apple STD	PA vegetable NMC			PA tomato STD
7	PA apple STD	PA vegetable NMC			MI melon STD		OR mint STD	MI cherry STD	PA vegetable NMC	ME potato STD	MN sugar beet STD	PA tomato STD
8		STX vegetable NMC	STX grapefr NMC	MS cotton STD	MO melon STD			GA peach STD	STX vegetable NMC	FL potato NMC		STX vegetable NMC
9		PA vegetable NMC							PA vegetable NMC	ME potato STD	MN sugar beet STD	
10	PA apple STD	PA vegetable NMC			MO melon STD		OR mint STD	MI cherry STD	PA vegetable NMC	ME potato STD	MN sugar beet STD	
11	NC apple STD	STX vegetable NMC		TX cotton OP	MO melon STD	WA onion NMC		Orchard BSS	STX vegetable NMC	FL potato NMC		
12	NC apple STD	STX vegetable NMC	STX grapefr NMC	STX cotton NMC	STX melon NMC	GA onion STD		Orchard BSS	STX vegetable NMC	FL potato NMC		STX vegetable NMC
13	CA fruit STD	STX vegetable NMC		TX cotton OP		CA onion STD		CA citrus STD	STX vegetable NMC	IDN potato STD		
West of Western Divide												
14	OR apple STD	CA row crop RLF						OR apple STD	CA row crop RLF	IDN potato STD		CA tomato STD
15	CA fruit STD	CA row crop RLF	CA citrus STD	CA cotton STD		CA onion STD		CA citrus STD	CA row crop RLF	CA potato RLF		
16	OR apple STD	CA row crop RLF						OR apple STD	CA row crop RLF	IDN potato STD	CA sugar beet OP	
17	OR apple STD	CA row crop RLF			CA melon RLF	WA onion NMC	OR mint STD	OR apple STD	CA row crop RLF	IDN potato STD	CA sugar beet OP	CA tomato STD
18	CA fruit STD		CA citrus STD	CA cotton STD	CA melon RLF	CA onion STD		CA fruit STD	CA row crop RLF	CA potato RLF		CA tomato STD

Table B3. EDWCs (µg/L) by use and by regional PCA specific to each HUC-2 region where that use may occur (values greater than 80 µg/L in bold).

Major Basin #	Apple	Carrot	Citrus	Cotton	Cucumber	Dry onion	Mint	Non-bearing fruit	Pepper	Potato	Sugar beet	Tomato
East of Eastern Divide												
1	4.3	17			7			14	9.9	10		34
2	14	57		72	23			47	33	33		**112**
3	8.4	**142**	70	55	**105**			**124**	67	**103**		**177**
Mid-Continent (Mississippi River Basin)												
4	23	**96**			29	61	10	38	54	55	**103**	**188**
5	25	**102**			68			**84**	58	59		**200**
6	8.4	47		55	32			41	27			**93**
7	26	**106**			32		11	42	60	61	**113**	**208**
8		**334**	53	**123**	71			26	**256**	**231**		**120**
9		**104**							59	59	**111**	
10	27	**109**			73		12	43	61	62	**116**	
11	18	**314**		**96**	67	8.4		**121**	**241**	**217**		
12	15	**263**	41	**94**	**147**	**163**		**101**	**202**	**182**		**95**
13	4.5	**110**		34		4.3		9.0	**84**	21		
West of Western Divide												
14	0.71	7.9						2.6	3.9	5.2		3.2
15	1.8	12	3.4	5.1		1.7		3.5	6.1	1.6		
16	2.8	32						10	15	21	10	
17	6.4	72			7.7	6.6	8.5	23	35	47	23	28
18	9.0		17	26	6.8	8.7		28	31	8.3		25

Appendix C. Degradate Summary.

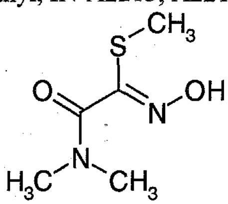
Table C1. Chemical Names, Structures, and Maximum Reported Amounts of the Degradates of Oxamyl.					
Name and Structure	**Maximum Percent of Applied Dose (interval)**	**% of applied dose at final sampling interval (study duration in days)**	**Reference**	**Study Type (OPPTS guideline)**	**Comments**
Oxime **IUPAC Name:** 2-Hydroxyamino-N,N-dimethyl-2-(methylthio)acetamide. 2-Hydroxyimino-N,N-dimethyl-2-(methylthio)acetamide Methyl N',N'-dimethyl-N-hydroxy-1-thiooxamimidate **CAS Name:** Methyl 2-(dimethylamino)-N-hydroxy-2-oxoethanimidothioate 2-(Dimethylamino)-N-hydroxy-2-oxo-ethanimidothioic acid, methyl ester **CAS. No.:** 66344-33-0 **Synonyms:** Oxamyl oxime, Oximino dimethyl, IN-A2213, A2213 	**93%** (increasing at end of study)	**93%** (30 d)	MRID 40606516	Hydrolysis (835.2120)	Study at pH 7
	83% (increasing at end of study)	**83%** (7 hr)	MRID 40606516		Study at pH 9
	75% (increasing at end of study)	**75%** (16 d)	MRID 40606515	Aqueous Photolysis (835.2240)	Study at pH 5
	13% (12 d)	2% (20 d)	ACC. # 147704	Soil Photolysis (835.2410)	Study at pH 6.5
	3% (7-14 d)	1% (51 d)	ACC. # 63012	Aerobic Soil Metabolism (835.4100)	Study at pH 6.4
	24% (10 d)	9% (51 d)	MRID 42820001		Study at pH 7.7
	51% (7 d)	Not detected (60 d)	MRID 45176602		Study at pH 7
	61% (28 d)	**41%** (42 d)	ACC. # 113366	Anaerobic Soil Metabolism (835.4200)	Study pH not reported
	2% (30 d)	<1% (60 d)	MRID 41346201		Study at pH 4.6
	70% (20 d)	**22%** (60 d)	MRID 42820001		Study at pH 7.7
	59% (1 d; system 1) **29%** (2 d; system 2)	<1% (100 d; system 1) <1% (100 d; system 2)	MRID 45045305	Aerobic Aquatic Metabolism (835.4300)	System 1 at pH 6.9-8.3 System 2 at pH 6.6-7.8
	0.11 ppm (0 d; FL) 0.29 ppm (13 d; WA) **2.7 ppm** (59 d; CA)	<0.02 ppm (382 d; FL) <0.02 ppm (365 d; WA) 0.43 ppm (180 d; CA)	MRID 41573201 /41963901	Terrestrial Field Dissipation (835.6100)	Maximum oxamyl concentrations were 12 ppm (0 d; FL), 5.9 ppm (7 d; WA), and 9.2 ppm (0 d; CA). Concentrations are from upper 15 cm of soil.
	0.11 ppm (30 d)	<0.01 ppm (359 d)	MRID 54045304		Maximum oxamyl concentration was 7.1 ppm (0 d). Concentrations are from upper 15 cm of soil in Mississippi.

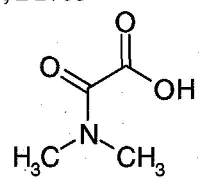
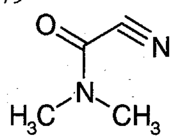
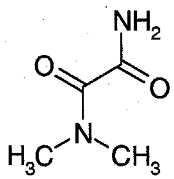
Table C1. Chemical Names, Structures, and Maximum Reported Amounts of the Degradates of Oxamyl.					
Name and Structure	**Maximum Percent of Applied Dose (interval)**	**% of applied dose at final sampling interval (study duration in days)**	**Reference**	**Study Type (OPPTS guideline)**	**Comments**
DMOA **IUPAC Name:** N,N-Dimethyl-oxalamic acid N,N-Dimethyl-oxamic acid **CAS Name:** (Dimethylamino)oxoacetic acid **CAS. No.:** 32833-96-8 **Synonyms:** Dimethyloxamic acid, IN-D2708, D2708	4% (35 d)	1% (51 d)	ACC. # 63012	Aerobic Soil Metabolism (835.4100)	Study at pH 6.4
	20% (21 d)	5% (51 d)	MRID 42820001		Study at pH 7.7
	35% (10 d)	<1% (31 d)	MRID 45176602		Study at pH 7.8
	86% (30 d)	**74%** (60 d)	MRID 41346201	Anaerobic Soil Metabolism (835.4200)	Study at pH 4.6
	23% (32 d)	9% (60 d)	MRID 42820001		Study at pH 7.7
	**79%** (30 d; system 1) **76%** (30 d; system 2)	1.9% (100 d; system 1) **58%** (100 d; system 2)	MRID 45045305	Aerobic Aquatic Metabolism (835.4300)	System 1 at pH 6.9-8.3 System 2 at pH 6.6-7.8
DMCF **IUPAC Name:** Cyano-methanoic acid dimethylamide **CAS Name:** Dimethylcarbonocyanidic amide 1-Cyano-N,N-dimethylformamide **CAS. No.:** 16703-51-8 **Synonyms:** Dimethylcyanoformamide, IN-N0079	**25%** (7 d)	9% (20 d)	ACC. # 147704	Soil Photolysis (835.2410)	Study at pH 6.5
	**17%** (30 d; system 1) **55%** (2 d; system 2)	<1% (100 d; system 1) <1% (100 d; system 2)	MRID 45045305	Aerobic Aquatic Metabolism (835.4300)	System 1 at pH 6.9-8.3 System 2 at pH 6.6-7.8

Table C1. Chemical Names, Structures, and Maximum Reported Amounts of the Degradates of Oxamyl.					
Name and Structure	**Maximum Percent of Applied Dose (interval)**	**% of applied dose at final sampling interval (study duration in days)**	**Reference**	**Study Type (OPPTS guideline)**	**Comments**
DMEA **IUPAC Name:** N,N-Dimethyl-oxalamide **CAS Name:** N,N-Dimethylethanediamide **CAS. No.:** 600-39-5 **Synonyms:** Dimethylethanediamide, IN-T2921 	**10%** (14 d; system 1) **14%** (2 d; system 2)	<1% (100 d; system 1) <1% (100 d; system 2)	MRID 45045305	Aerobic Aquatic Metabolism (835.4300)	System 1 at pH 6.9-8.3 System 2 at pH 6.6-7.8
Carbon dioxide **IUPAC Name:** Carbon dioxide **CAS Name:** Carbon dioxide **CAS. No.:** 124-38-9 O=C=O	**43%** (increasing at end of study)	**43%** (20 d)	ACC. # 147704	Soil Photolysis (835.2410)	Study at pH 6.5
	63% (increasing at end of study)	**63%** (51 d)	ACC. # 63012	Aerobic Soil Metabolism (835.4100)	Study at pH 6.4
	45% (increasing at end of study)	**45%** (51 d)	MRID 42820001		Study at pH 7.7
	76% (increasing at end of study)	**76%** (31 d)	MRID 45176602		Study at pH 7.8
	3% (increasing at end of study)	3% (42 d)	ACC. # 113366	Anaerobic Soil Metabolism (835.4200)	Study pH not reported
	14% (increasing at end of study)	**14%** (60 d)	MRID 41346201		Study at pH 4.6
	76% (increasing at end of study)	**76%** (31 d)	MRID 42820001		Study at pH 7.7
	63% (increasing at end of study; system 1) **30%** (increasing at end of study; system 2)	**75%** (100 d; system 1) **31%** (100 d; system 2)	MRID 45045305	Aerobic Aquatic Metabolism (835.4300)	System 1 at pH 6.9-8.3 System 2 at pH 6.6-7.8

Appendix D. Model Output Samples.

The following are sample model outputs for SCI-GROW and PRZM/EXAMS that represent the maximum use patterns of oxamyl. The remaining model outputs were not included due to their extensive collective size.

SCI-GROW Output

SciGrow version 2.3
chemical:Oxamyl
time is 10/17/2008 18: 1:56

Application rate (lb/acre)	Number of applications	Total Use (lb/acre/yr)	Koc (ml/g)	Soil Aerobic metabolism (days)
1.000	10.0	10.000	1.00E+01	11.0

----

groundwater screening cond (ppb) = 1.26E+00
****

PRZM/EXAMS Sample Output

stored as STXveg-Oct15.out
Chemical: Oxamyl
PRZM environment: STXvegetableNMC.txt modified Thuday, 14 June 2007 at 09:18:16
EXAMS environment: ir298.exv modified Thuday, 29 August 2002 at 14:34:12
Metfile: w12919.dvf modified Wedday, 3 July 2002 at 08:06:24
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	184	137	53.38	20.93	14.1	3.477
1962	48.01	35.48	13.94	6.713	5.378	1.356
1963	10.47	7.398	5.089	3.099	2.548	0.7374
1964	107	82.28	34.52	13.08	9.879	2.443
1965	32.62	24.53	9.622	5.771	3.918	1.044
1966	893	645	240	87.04	58.45	14.41
1967	130	93.77	36.6	13.82	9.298	2.655
1968	47.6	35.16	13.82	6.597	4.409	1.11
1969	18.47	14.52	8.498	5.036	3.426	1.132
1970	90.02	64.6	25.71	10.46	6.977	1.736
1971	15.87	11.5	6.155	2.563	2.08	0.7481
1972	215	152	59.53	22.67	15.13	3.779
1973	10.47	7.402	4.42	1.896	1.265	0.3721
1974	147	107	44.7	17.69	11.82	2.927
1975	153	113	44.05	17.92	12.53	3.098
1976	664	496	209	83.6	55.85	13.77
1977	80.02	59.31	31.35	15.71	10.53	2.606
1978	14.45	11.63	5.361	2.582	2.408	0.6007
1979	171	122	48.72	20.78	14.14	3.63
1980	35.77	29.71	12.83	8.695	5.918	1.476
1981	63.77	46.25	22.62	9.62	6.435	1.59
1982	275	205	80.03	31.89	21.87	5.414
1983	10.47	7.429	4.467	2.108	1.406	0.3612
1984	66.77	48.92	18.64	8.676	6.435	2.044

1985	142	100	48.4	19.19	12.87	3.198
1986	395	305	122	47.64	31.99	7.965
1987	371	287	121	52.16	34.85	8.601
1988	64.24	46.1	19.46	8.283	5.526	1.366
1989	120	95.67	56.4	22.4	15.02	3.843
1990	342	244	93.08	34.61	23.08	5.695

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	893	645	240	87.04	58.45	14.41
0.0645161290322581	664	496	209	83.6	55.85	13.77
0.0967741935483871	395	305	122	52.16	34.85	8.601
0.129032258064516	371	287	121	47.64	31.99	7.965
0.161290322580645	342	244	93.08	34.61	23.08	5.695
0.193548387096774	275	205	80.03	31.89	21.87	5.414
0.225806451612903	215	152	59.53	22.67	15.13	3.843
0.258064516129032	184	137	56.4	22.4	15.02	3.779
0.290322580645161	171	122	53.38	20.93	14.14	3.63
0.32258064516129	153	113	48.72	20.78	14.1	3.477
0.354838709677419	147	107	48.4	19.19	12.87	3.198
0.387096774193548	142	100	44.7	17.92	12.53	3.098
0.419354838709677	130	95.67	44.05	17.69	11.82	2.927
0.451612903225806	120	93.77	36.6	15.71	10.53	2.655
0.483870967741936	107	82.28	34.52	13.82	9.879	2.606
0.516129032258065	90.02	64.6	31.35	13.08	9.298	2.443
0.548387096774194	80.02	59.31	25.71	10.46	6.977	2.044
0.580645161290323	66.77	48.92	22.62	9.62	6.435	1.736
0.612903225806452	64.24	46.25	19.46	8.695	6.435	1.59
0.645161290322581	63.77	46.1	18.64	8.676	5.918	1.476
0.67741935483871	48.01	35.48	13.94	8.283	5.526	1.366
0.709677419354839	47.6	35.16	13.82	6.713	5.378	1.356
0.741935483870968	35.77	29.71	12.83	6.597	4.409	1.132
0.774193548387097	32.62	24.53	9.622	5.771	3.918	1.11
0.806451612903226	18.47	14.52	8.498	5.036	3.426	1.044
0.838709677419355	15.87	11.63	6.155	3.099	2.548	0.7481
0.870967741935484	14.45	11.5	5.361	2.582	2.408	0.7374
0.903225806451613	10.47	7.429	5.089	2.563	2.08	0.6007
0.935483870967742	10.47	7.402	4.467	2.108	1.406	0.3721
0.967741935483871	10.47	7.398	4.42	1.896	1.265	0.3612
0.1	392.6	303.2	121.9	51.708	34.564	8.5374
			Average of yearly averages:			3.43948333333333

Inputs generated by pe5.pl - Novemeber 2006

Data used for this run:

Output File: STXveg-Oct15				
Metfile:	w12919.dvf			
PRZM scenario:	STXvegetableNMC.txt			
EXAMS environment file:	ir298.exv			
Chemical Name:	Oxamyl			
Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	219	g/mol	
Henry's Law Const.	henry		atm-m^3/mol	
Vapor Pressure	vapr	3.8e-7	torr	
Solubility	sol	2.8e5	mg/L	
Kd	Kd		mg/L	

Koc	Koc	35	mg/L	
Photolysis half-life	kdp	14	days	Half-life
Aerobic Aquatic Metabolism	kbacw	6.6	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	0	days	Halfife
Aerobic Soil Metabolism	asm	52	days	Halfife
Hydrolysis:	pH 7	8.0	days	Half-life
Method:	CAM	2	integer	See PRZM manual
Incorporation Depth:	DEPI		cm	
Application Rate:	TAPP	4.484	kg/ha	
Application Efficiency:	APPEFF	0.99	fraction	
Spray Drift	DRFT	0.064	fraction of application rate applied to pond	
Application Date	Date	15-10	dd/mm or dd/mmm or dd-mm or dd-mmm	
Interval 1	interval	5	days	Set to 0 or delete line for single app.
app. rate 1	apprate	1.121	kg/ha	
Interval 2	interval	5	days	Set to 0 or delete line for single app.
app. rate 2	apprate	1.121	kg/ha	
Interval 3	interval	5	days	Set to 0 or delete line for single app.
app. rate 3	apprate	1.121	kg/ha	
Interval 4	interval	5	days	Set to 0 or delete line for single app.
app. rate 4	apprate	1.121	kg/ha	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index Res. Run	IR	Reservoir		
Flag for runoff calc.	RUNOFF	total	none, monthly or total(average of entire run)	